DECEMBER • 1948

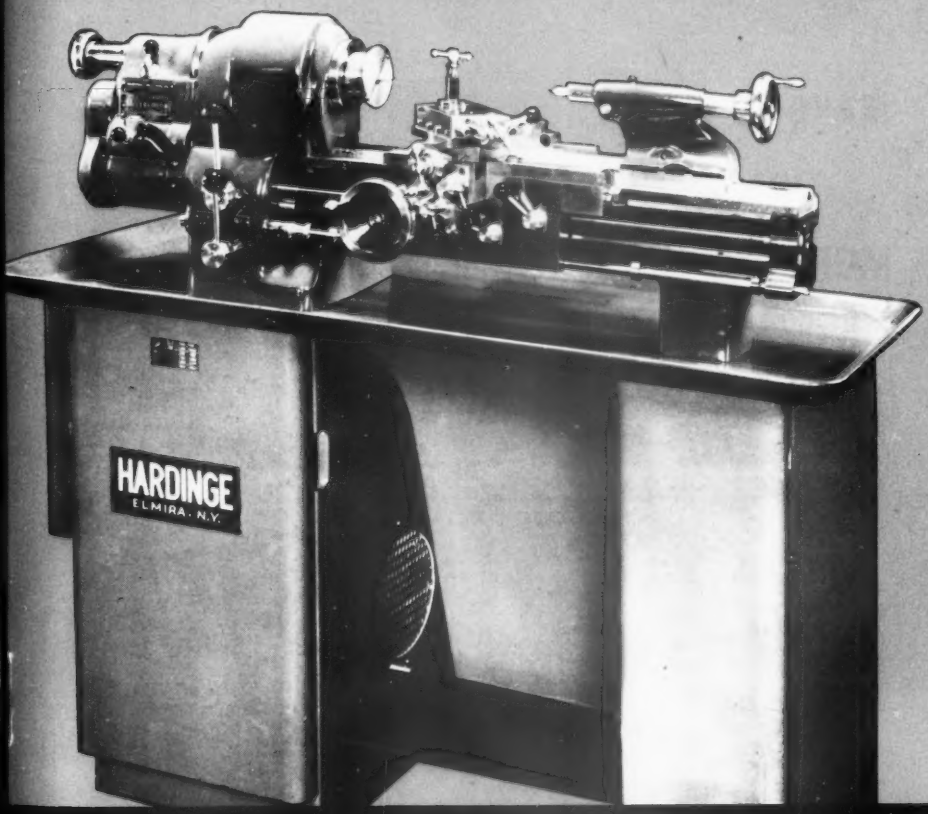
TOOL & DIE JOURNAL

DESIGN, MANUFACTURE AND USE OF PRODUCTION TOOLING

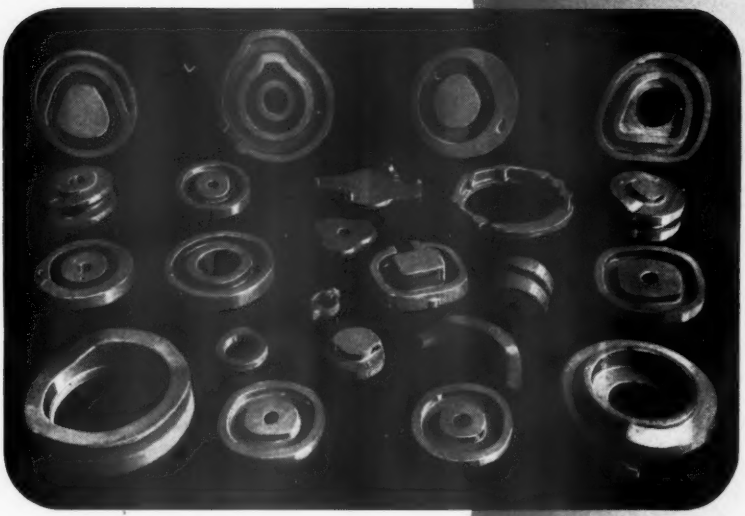
HARDINGE
ELMIRA, N.Y.

HIGH SPEED PRECISION TOOL ROOM LATHE

The outstanding machine for collet work of one inch or less in diameter



"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"



MAKE YOUR CAMS THIS MODERN MONEY-SAVING WAY

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This NEW Bellows-Senacon

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WILL DO EVERYTHING BUT DRAW A PAY CHECK!

Answer to today's problem of *extra* production from each cost dollar, Bellows-Senacon DFE Drill Press Feeds will substantially increase production on drill press operations: drilling, tapping, reaming, fly-cutting, or others.*

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* *Designed primarily for Drill Press operation, Bellows-Senacon Feeds are readily adaptable to Milling Machines, Threaders, Grinding Machines, etc.*

Model "DFE" Feeds are built with simple, positive, readily adjustable controls to make possible correct feeding rates, power thrusts, etc., for virtually any tool, working in virtually any stock. Independent speed controls permit infinite variation of feed and traverse rates. Feeding thrust can be varied to any desired degree. The Bellows Hydro-Check, an adjustable hydraulic resistance unit (optional equipment) assures utmost smoothness of feed, permits checking the feed at the point of breakthrough or at any other predetermined point. Three models with stroke lengths permitting one and one-half, one, or one-third revolutions of the drill press shaft.

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TOOL & DIE JOURNAL

Editorial and Publication Offices
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Tool & Die Journal is published monthly for those industry key men who constitute, in each plant, the Cycle of Buying Influence —CBI—and who are responsible for the design, manufacture and use of production tooling.

Subscription rate: To Schools, Libraries, Students, and other than CBI, $4.00 per year. Single copies fifty cents.

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Top honors in the field of farm machinery production go to the punch press because the press is the fastest means of accurately duplicating metal parts.

Danly Die Sets, a part of good presswork everywhere, speed die making programs, prevent excessive tool wear and expensive regrinds, because of their *known dependable accuracy.*

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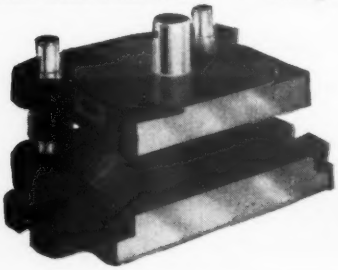

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may get you

half a wheel

Write for the Simonds Abrasive Data Book

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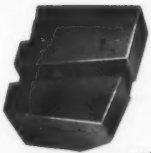
CUTTER

BACK VIEW OF CUTTER



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Specify SUPER Solid Carbide Inserted Blade Milling Cutters for extra machining efficiency and low tool cost. You get the outstanding economy of virgin Tungsten Carbide in these versatile cutters that machine *any* material.

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HEAVY DUTY
MODEL 4

THE HEINRICH

HANDNIB

FOR

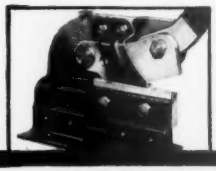
- ✔ OUTSIDE NIBBLING
- ✔ INSIDE NIBBLING
- ✔ SHEARING
- ✔ DRILL ROD CUTTING

INSIDE NIBBLING SHEARING DRILL ROD CUTTING

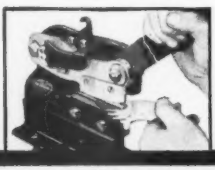
• The Heinrich "Handnib" enables tool makers to speed up cutting of templates, trial blanks, experimental pieces, etc., into any irregular shape. Saves hours of slow, hand work. Double crank construction makes the Heavy Duty Model 4 "Handnib" the easiest hand-operated nibbling-shearing tool on the market. The frame is cast steel, and all wearing parts are hardened and ground for life-time service. Nibbles inside and outside and shears flat stock up to 3/16". Cuts round stock up to 3/8". Inside nibbling depth of cut, 4" from any edge. May be clamped in a bench vise or mounted on a bench. Write for descriptive folder with full information on this and other Heinrich "Handnib" models.

★ ★ ★ FOUR OTHER HEINRICH TIME SAVERS ★ ★ ★

Model 1 • For Shearing only. Capacity up to 1/8" flat stock.

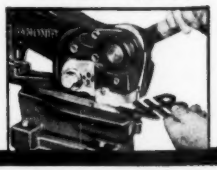


Model 2 • For Outside Nibbling and Shearing of flat stock up to 1/8".



Model 3 • Same as Model 4, but capacity up to 1/8" flat stock.

Model 5 • An inside and outside nibbler, shear, rod cutter, punch.



NATIONAL MACHINE TOOL COMPANY

MANUFACTURERS OF "GRIP-MASTER," THE WORLD'S FASTEST VISE

DEPARTMENT 186-M • RACINE, WISCONSIN

Injection Molds Completed

5 TIMES FASTER ON A GORTON

3-DIMENSIONAL PANTOGRAPH

JOB FACTS

NAME OF PART—Injection Mold.
MATERIAL—Tool Steel (oil hardening).
MACHINE—Gorton 3-Dimensional Engraver Model 3-L.
ATTACHMENTS—Standard three jaw chuck mounted on table.
TOOLS USED—Special Cutters ranging from .035" dia. to .340" dia.
TEMPLATE USED—2 to 1 frill shape master.
FORMER TIME—15 hours per mold.
PRESENT TIME—3 hours per mold.
ACCURACIES—All dimensions held to .0005".

Machining Time Reduced from 15 Hours to 3 Hours per Mold

ACCURACIES HELD TO .0005"

Here's an example of the type of performance you'll get on a Gorton 3-Dimensional Pantograph Engraving Machine. This large manufacturer experienced difficulty in the production of these injection molds. Time required was 15 hours per mold. Accuracies were hard to maintain. Machine down-time was excessive. Man hours were wasted.

In an effort to remedy these, the job was tooled-up on a Gorton 3-Dimensional Engraving Machine. First an enlarged master template was cut. Then, using this as a pattern, the desired molds were turned out at the correct size at the rate of one every 3 hours. The other disturbing factors were also remedied. Dimensions were held to .0005" due to Gorton pantographic reduction method. Down-time was drastically reduced. Man hours were conserved.

QUALITY WORK ON A PRODUCTION BASIS

Gorton Pantograph Machines are noted for the consistency with which they turn out quality work on a production basis. They are available in both 2 and 3-dimensional models to handle many types of reproduction assignments. They can be used with high efficiency on any machinable material and their operation is extremely simple.

HOW TO PREDETERMINE THE RESULTS OF TOOLING YOUR JOB ON A GORTON PANTOGRAPH

Send detail prints or a work sample to Gorton Engineering Service at the address below. Tooling information and production estimates will be furnished promptly—no charge or obligation. You can then predetermine the possible improvement over your present methods.

GEORGE GORTON MACHINE CO.
1212 RACINE STREET, RACINE, WISCONSIN, U.S.A.

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Get the details on Gorton Pantographs and other Gorton machines by sending today for your copy of Bulletin No. 1655.

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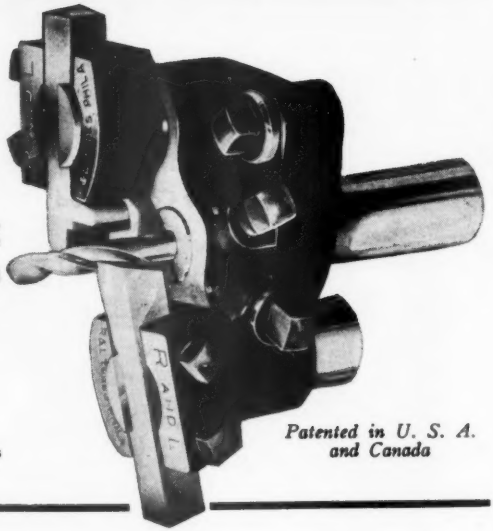
When The Tool Is an R and L Combination Turning Tool

One R and L Combination Turning Tool, the only combination right hand and left hand tool on the market, actually does the work of 14 tools.

You can use an R and L for all these right hand or left hand applications:

- Roller Box Tool
- Centering and Facing Tool
- Knee Tool
- Pointing Tool
- Back Rest
- Floating Drill Holder
- Balanced Turning Tool

The change from right to left or vice versa takes only ten seconds.



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√ *CHECK THESE OUTSTANDING FEATURES*

- **Made of extra tough, heat treated alloy steel; unconditionally guaranteed not to bend or give way.**
- **Essential parts ground to extreme accuracy affording perfect alignment at any point of adjustment.**
- **Back Rests, or burnishers, have almost diamond hard surfaces eliminating metal pick-up and marring of work surface.**
- **Interchangeable Roller Back Rests furnished if desired.**
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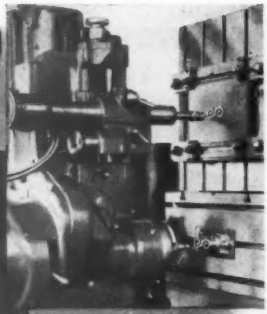
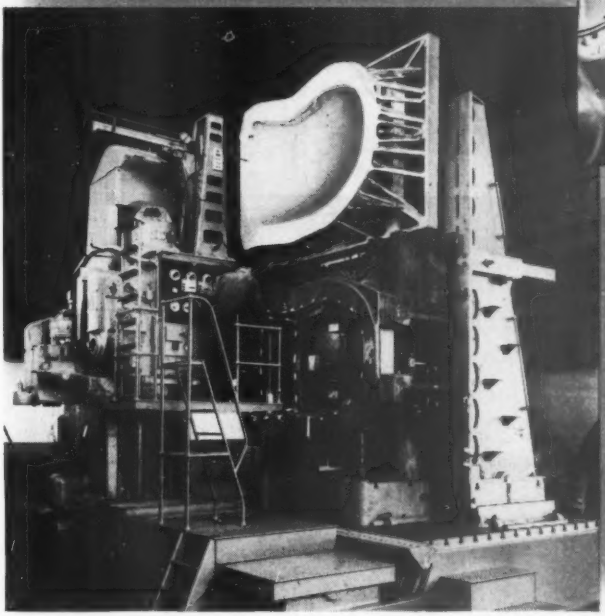
- **Tool bits wear longer because they are ground only on top side, or end.**
- **Less cross-slide clearance required; saves time and often permits working with cross-slide tools while turning or drilling.**
- **On turnings, the R and L Combination Tool produces highly polished surfaces, true to size, and straight.**
- **Usable either for roughing or finishing; extra heavy cuts possible because thrust is always in direct line with Back Rest.**
- **Longitudinal adjustment permits turning of two diameters to any length within tool capacity.**

All these and many other features are shown by photographs and drawings in descriptive booklet mailed without cost or obligation. The booklet illustrates the tool set-up for various operations, and indicates speed and simplicity of its adaptation to various jobs. Prices and full specifications of many available sizes are included. Write for your copy today.

R and L TOOLS *1825 Bristol St., Philadelphia 40, Pa.*

KELLER TRACER-CONTROLLED MILLING





(Above) A Keller GG machine produces the punch for a small electrical contact spring.

(Left) Keller BG-3 Machine produces a three-dimensional die for a large auto body part.

Makes Dies and Molds of all Types and Sizes

A small part? Say a little electrical contact spring? The Keller Machine will make both the punch and die to mass produce it, from a model made from wood, plaster or other easily workable pattern material, or from one of the parts themselves.

A big part? Say a section of an automobile body? The sensitive electrically-controlled tracer will feel out the most intricate design in the model and duplicate it in a die, a mold or even a pilot model milled from steel, Duralumin or similar metal.

Yes, and the Keller Machine will produce dies and molds between those two extremes . . . any two- or three-dimensional shape up to 2½ x 6 x 12 feet.

Reduce tooling costs. Cut experimental costs. Use the Keller process of tracer-controlled milling. There are several machines to cover the range of your requirements. Write today for full information.

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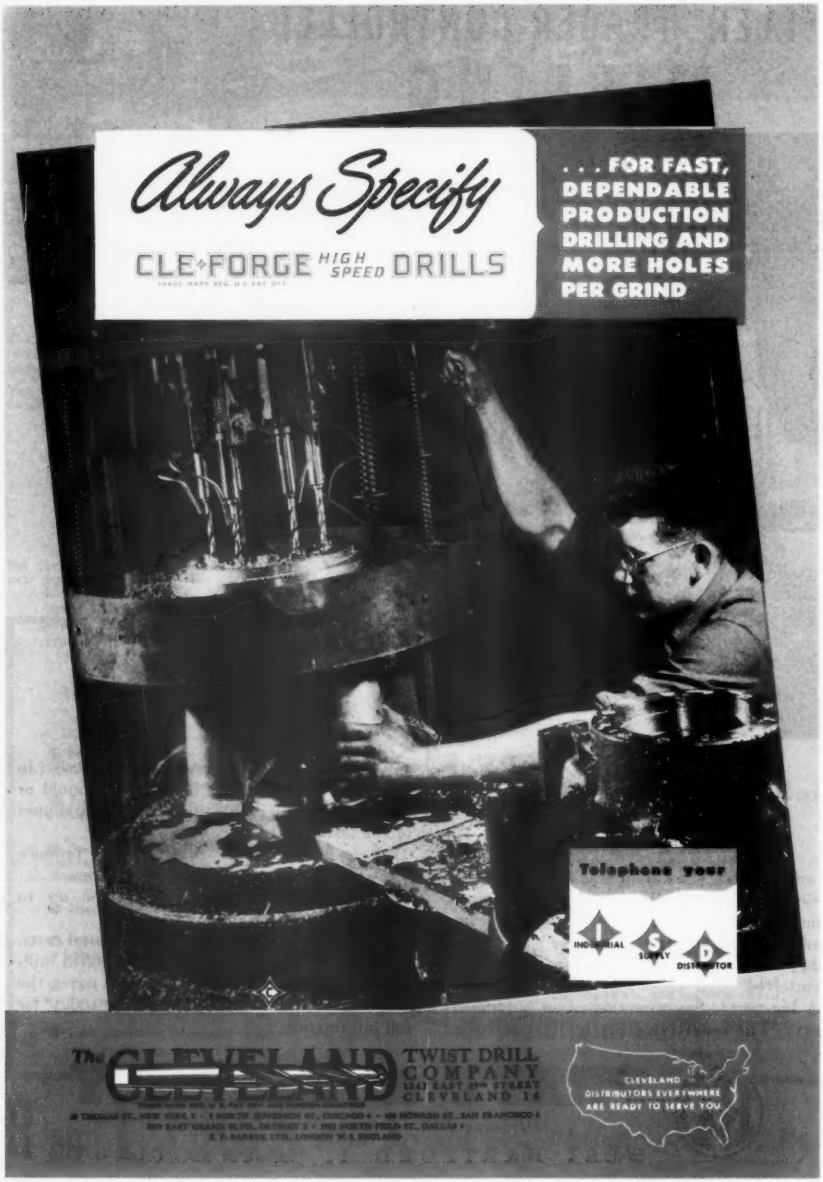
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Combined with its accessories and exclusive attachments, the Handee Tool performs more operations with greater accuracy than any other portable electric tool at any price.

PRECISION ATTACHMENTS. Fit Handee only. Offhand carving, routing, shaping is exact as to depth of cut, accuracy of line. Indispensable to pattern shop. Set of 6, postpaid, $7.95

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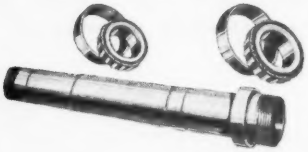

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SHELDON
Precision Lathe

NEW . . . an 11" lathe with "Zero Precision" Tapered Roller Spindle Bearings.

NEW . . . a moderate priced lathe with precision unsurpassed in any price class.

NEW . . . the well known "S56" now combining 11¼" swing, 1" collet capacity and zero precision tapered roller bearings.

SPECIFICATIONS

Headstock Bearings—Tapered Roller Bearings, Zero Precision
Collet Capacity—1 inch (round)
Hole Through Spindle—1⅜ inch
Swing—11¼ inches
Bed Length—56 inches
Distance Between Centers—35 inches
Spindle Drive—Double V-Belt
Spindle Speeds—8 speeds
Full Quick Change Gears—48 right and left changes, 2 to 224 threads per inch
Full Double Walled Apron—Worm driven longitudinal and cross feeds.
Dovetail Taper Gibs—Compound Rest and Cross Slide have screw adjusted tapered gibs to take up wear.
Underneath Motor Drive—4-Speed, V-Belt fully enclosed in bench pedestal.
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Write for the TRB-S56 circular

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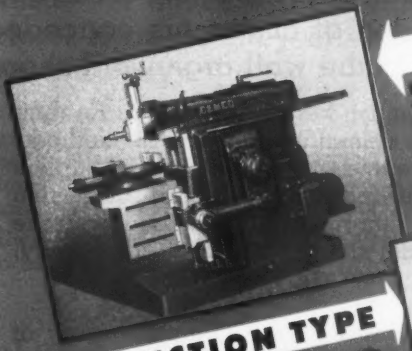

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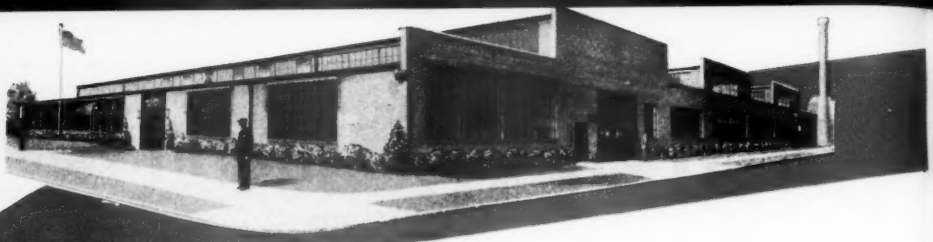
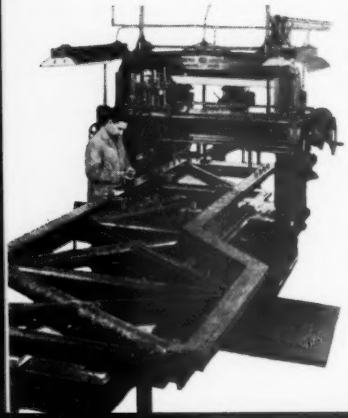


Aren't These
The Factors You Also Want in

QUESTIONNAIRED recently by a leading technical publication as to the future of contract tool and die shops, a list of customers conceded continuing prosperity to the well organized shops

(A) The management must be capable of counseling the customers in the selection of correct methods, processes and equipment and must have a complete corps of technically trained, experienced craftsmen capable of designing, engineering and building the needed tools, dies, jigs, fixtures, special machinery, etc. . . .

(B) The tool contractor must have a complete array of advanced machinery in various types and sizes including expensive specialized machines not regularly required in a large majority of shops but absolutely essential to the production of modern, efficient tooling equipment. . . .



(C) Inspection facilities must be thorough and complete both as to equipment and specially trained personnel; and the policy must be such as to make mandatory its exacting and consistent use. . . .

(D) The contractor should be financially responsible and highly ethical in business principles to earn and retain the confidence of the customer. . . .

* * *

Ask a Representative to Call

Write for Illustrated Bulletin

Tooling Service?

but named among numerous "musts" for success the following factors. How do they check with your thinking?

McKINNEY retains one of the industry's largest groups of creative tool specialists and tool building technicians and enjoys a continuing large volume of business that minimizes employee turnover.

Always available are these essential workers so hard to obtain and retain today.

McKINNEY's inventory of tools, machinery and inspection equipment is unusually complete. Few tool shops can equal it and only rarely do even the large plants have comparable equipment.

McKINNEY maintains a policy of inspection at each stage of progress, not only to assure the required accuracy and efficiency in the finished tools but also to avoid delays and expense through possible errors.

McKINNEY's policy is to keep constantly in mind the *end performance* of tooling equipment, to see that those tools give the desired results *on the job* and to make available to customers prompt and efficient maintenance and repair service.

Financially, McKinney rates among the highest.

Designing and Engineering

Main Bay

Inspection Crib

Boring Mills

McKINNEY TOOL & MFG. CO.
CLEVELAND
DESIGNERS and BUILDERS of PRECISION TOOLING
Since 1920
1673 Arabella Road
Tools · Dies · Jigs · Fixtures · Special Machinery

Concave, convex or flat surfaces on machinery, dies, patterns, tools, castings, steel forgings, pottery, metal sheets, plastics, bakelite, rubber and stone can be finished faster, easier, cheaper with this high speed Mall Countershaft Grinder. In addition, it gets to hard-to-reach places on machines or other industrial equipment. A big time, labor and material saver for bench work or when rolled to the product. Full ball bearing mounted spindles make for vibration-free, cool operation.

Mall High Speed Countershaft GRINDERS are available in ¾ H.P.—speed range from 1650 to 7400 r.p.m.—also Mall Rotary Hand Cut and Mill Cut Files in coarse, medium or fine grades, in a wide variety of shapes.

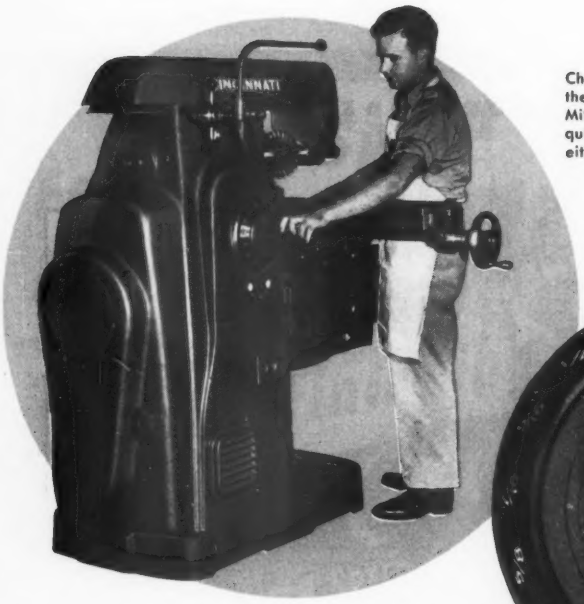
Ask your supplier or write for literature.

FLEXIBLE SHAFT DIVISION

Mall Tool Company • 7724 South Chicago Ave. • Chicago 19, Ill.

25 Years of "Better Tools For Better Work"

END MILLS FOR MODERN PRODUCTION
THE Electrical Industry is another big user of Putnam end mills. More than 800 standard sizes and types of Putnam end mills—the country's largest and most complete selection—are immediately available at all times from full distributor and factory stocks.
PUTNAM
TOOL COMPANY
2985 CHARLEVOIX AVENUE • DETROIT 7, MICHIGAN

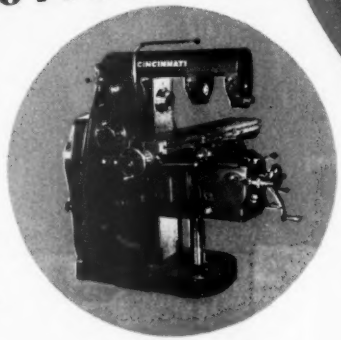


Changing speeds and feeds on the new CINCINNATI No. 2 MI Milling Machine is easy and quick—a half turn of the crank on either dial is all that's necessary.

Direct reading Feed Dial

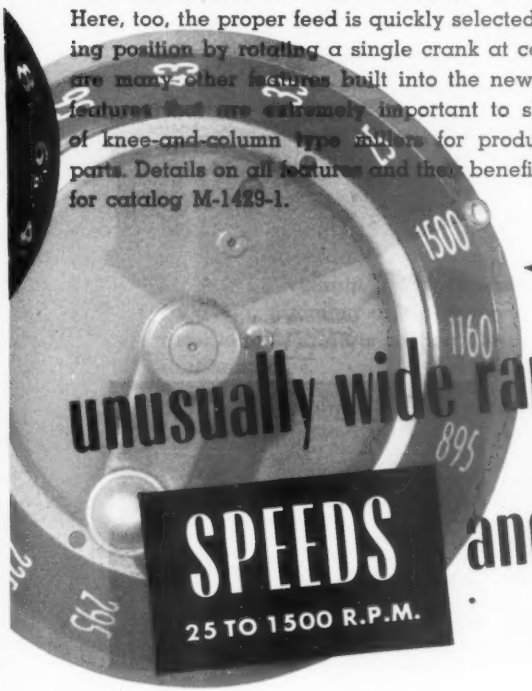
The New CINCINNATI NO. 2 MI offers an

CINCINNATI



The new CINCINNATI No. 2 MI Millers are available in Plain, Universal and Vertical styles. Complete engineering specifications are contained in catalog M-1429-1.

THE new CINCINNATI No. 2 MI Milling Machine has sixteen spindle speeds —25 to 1500 r.p.m. (60 to 1 ratio)—offering top efficiency in milling operations on parts made of various grades of steel, cast iron, aluminum and bronze, using cutters ranging from face mills to small end mills . . . for high speed carbide milling as well as operations employing conventional high speed steel cutters. Selection of the next increment of speed is easily and quickly made by a half turn of a single crank on the speed dial. ¶Then there are sixteen feeds, ¼" to 30" per minute (120 to 1 ratio). Here, too, the proper feed is quickly selected from operator's normal working position by rotating a single crank at center of feed dial. ¶And there are many other features built into the new CINCINNATI No. 2 MI Miller—features that are extremely important to shops requiring the versatility of knee-and-column type millers for producing small- to medium-sized parts. Details on all features and their benefits may be obtained by writing for catalog M-1429-1.



← Direct reading Speed Dial

unusually wide range of SPEEDS and FEEDS

25 TO 1500 R.P.M.

¼" TO 30"

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI 9, OHIO, U. S. A.

MILLING MACHINES • BROACHING MACHINES • CUTTER SHARPENING MACHINES

The JIGMIL has proven to be a totally new approach to the problems of economical precision BORING and milling of tool and production work

THE fastest producing and most accurate machine in the field.

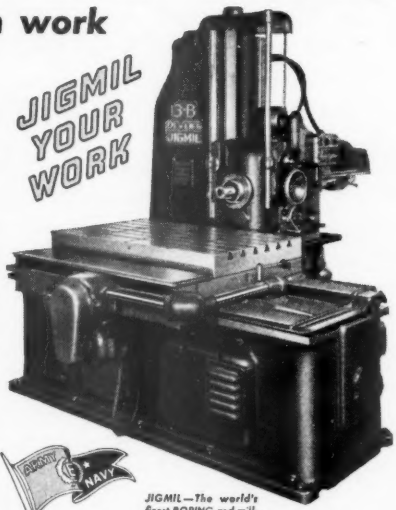
Many users are reporting consistent experience of two to three times the output and higher quality work.

Automatic positioning of spindle from one location to another in response to measuring rods and push buttons to within less than .0001 (one ten-thousandth part of an inch).

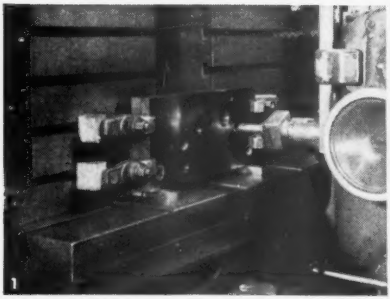
Feather touch, pressure controlled slide locks that positively control locking uniformity, so essential to high precision work.

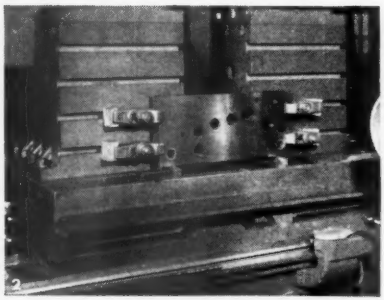
Unique operation and controls that make possible high precision work with relatively little skill.

★ ★ ★



JIGMIL—The world's finest BORING and milling machine is made in Detroit.





★ **No. 1—Illustration showing convenience of jig plate boring. No. 2—Eight holes precision bored. Holes spaced within .0001 with total dependence of all spacing on automatic positioning means.**

DeVLIEG MACHINE COMPANY DEVLIEG JIGMIL **450 FAIR AVE. FERNDALE 20, (Detroit) MICH.**

Star Is Now Keller Equipped

for quick, accurate, automatic contour and profile milling of blanking, trimming and piercing dies and punches; extrusion dies; forging and die casting dies; plastics molds; gages; cams and templates.

This Keller machine, the largest in a contract tool and die shop in this area, will produce your tooling requirements from models or machine the most intricate shapes and forms.

Write us today and include blueprints for quotations and delivery schedule.

Founded in 1902

Custom Tool and Die Makers

DESIGNERS AND MANUFACTURERS
OF DIES • JIGS • FIXTURES • GAGES
SPECIAL MACHINERY

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STAR ★
MACHINE & TOOL COMPANY

9320 Woodland Ave • Cleveland 4, Ohio

Increase Shop Capacity and Efficiency

Increase shop efficiency and you increase production capacity. Work moves smoothly, swiftly, surely, and in greater volume, through the efficient shop. Modern, efficient, precision machine tools are one of the first essentials for maximum efficiency.

Famous for versatility, South Bend Precision Lathes bring peak efficiency to shops where frequent changes of set-up are called for and a variety of materials are used. And their modern design, with convenient controls and full quick change gear equipment, means less fatigue and less "machine scrap" due to such causes.

If your shop problem is to increase efficiency, it will pay to consider the installation of South Bend Precision Lathes when new equipment is added, or present equipment is replaced.

Send For Catalog

Catalog 100-D shows in color all sizes and models of South Bend Toolroom, Turret, and Engine Lathes. Made in 9", 10", 13", 14-1/2", and 16" swings. Accessories and attachments shown.

LATHE BUILDERS SINCE 1906

SOUTH BEND LATHE WORKS

432 EAST MADISON STREET • SOUTH BEND 22, INDIANA

FACTS ABOUT END MILLS

Excessive speeds should be avoided in operating end mills because this quickly destroys the cutting edges. For deep cuts or comparatively soft materials, two-flute end mills should be used. For hard materials, shallow cuts, or work requiring a very exacting finish, finer tooth end mills are better suited. For all types of end mills, you are assured of more accurate work at minimum cost when you specify **NATIONAL** tools — the National choice.

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DISTRIBUTOR

Leading distributors in every section of the country have complete stocks of National Cutting Tools. Every National distributor has a factory trained man to serve you. Call your National distributor for cutting tools or any staple industrial product.

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TWIST DRILL AND TOOL COMPANY
ROCHESTER, MICH., U.S.A.

FOR 50 YEARS A LEADER

Modern Facilities with The Same Old Skills

THE J. C. Ulmer Company has served American Industry since 1893—developing and building special production machines and other precision tools, gages, jigs and fixtures so vital to low cost mass production.

For over fifty years a leader, The J. C. Ulmer Company has continually acquired the latest, most modern facilities to supplement their years of "know-how" and handed-down skill of their master toolmakers.

Years of successful operation, experienced craftsmen, engineers and management, the most modern facilities and the "habit of precision" are the ingredients that go into every Ulmer-made special machine, tool, gage, jig and fixture.

The J. C. Ulmer Company invites you to submit drawings, specifications or samples for detailed and accurate suggestions and estimates, or if you prefer, ask us to send our representative—there is no obligation, of course.

A catalog listing complete facilities and services available on request.

1893—FACILITIES—1893

1 Foot Treadle Reed Lathe
1 "Pot-Belly" Stove
50 Cigar Boxes of Assorted Screws, Bolts, Nuts
1 Anvil
1 Vise
1 Bench and Chair
Assorted Hand Tools

Master Craftsmanship and "The Habit of Precision"

1918—FACILITIES—1918

Benches for Assembly	1 Landis Grinder
5 Lathes	1 Hardening Furnace
2 Bench Lathes	1 Punch Press
4 Milling Machines	1 Drill Press
1 Hand Miller	Dividing Heads
3 Hand Grinders	

Master Craftsmanship and "The Habit of Precision"

1946—FACILITIES—1946

1-18" x 10' Hendey Engine Lathe
3-16" x 8' Hendey Engine Lathes
2-14" x 6' Hendey Engine Lathes
4-Bench Lathes
2-Schauer Speed Lathes
1-No. 7 B&O Turret Lathe
1-No. 5 B&O Turret Lathe
1-No. 4 W&S Turret Lathe
1-No. 2 W&S Turret Lathe
1-12½ x 20" Monarch Engine Lathe
4-No. 2 B&S Universal Milling Machines
1-No. 22L Van Norman Milling Machine
1-No. 3 Hendey Universal Mill
1-No. 2 Cincinnati Mill
1-No. 2 Reed Prentice Vertical Mill
1-No. 38 Universal Mill
1-Hand Miller
2-No. 3 Cincinnati Mills
1-Bridgeport Milling Machine
2-Bridgeport Vertical Heads
1-24" Hendey Shaper
1-21" Averbeck Shaper
1-12" Hendey Shaper
3-20" Hendey Shapers
1-20" G&E Shaper
1-Cincinnati Planer
1-No. 5 Brown & Sharpe Grinder
1-No. 2 Brown & Sharpe Grinder
2-No. 3 Brown & Sharpe Grinders
1-No. 1½ Landis Internal Grinder
2-No. 13 B&S Universal Grinders
2-LeBlond Tool & Cutter Grinders
2-No. 55 Gallmeyer & Livingston Wet Surface Grinders
2-No. 35 Gallmeyer & Livingston Wet Surface Grinders
3-B&S Surface Grinders
11-Hammond Surface Grinders
1-Majestic Internal Grinder
2-9" Spindle Delta Drill Presses
1-21" Cincinnati Bickford Drill Press
14-Drill Presses of various sizes
1-No. 6 Swiss Jig Borer
1-No. 31 Lucas Boring Mill
1-Gorton Engraving Machine
1-JD Continental DoALL Saw
1-No. 26 Continental DoALL Saw
1-3½' Cincinnati Bickford Radial Drill
1-4' Carlton Radial Drill
1-Grob Filing Machine
1-Thiel Filing Machine
2-Oliver Bench Filers
2-Sunnen Honing Machines
1-J&L Comparator
1-Wilder Comparator
1-7½ Ton Electric Crane
1-Sand Blast Cabinet
1-Ingersoll-Rand Air Compressor, 100 cu. ft. per min. Inner and After cooler.

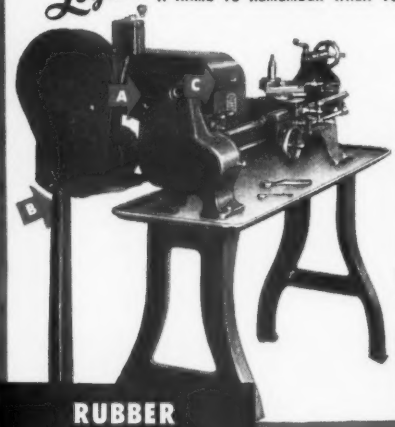
Master Craftsmanship and "The Habit of Precision"

The Habit of Precision
Since 1893

THE J. C. ULMER COMPANY

1791 EAST 38th STREET • CLEVELAND 14, OHIO

Logan A NAME TO REMEMBER WHEN YOU THINK OF BETTER LATHES



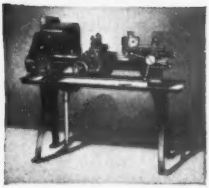
RUBBER CUSHIONED COUNTERSHAFT

WHERE FIVE RUBBER CUSHIONS ASSURE SMOOTH OPERATION IN LOGAN LATHES

A — TWO RUBBER CUSHIONED BEARINGS, one at each end of the two hinge points connecting countershaft and headstock.

B — ONE RUBBER CUSHION between motor mounting base and pedestal.

C — TWO RUBBER BUTTONS cushion the cone pulley guard.



Quick Change Gear Turret Lathe

SPECIFICATIONS COMMON TO ALL LOGAN LATHES . . . swing over bed, 10½" . . . bed length, 43⅛" . . . size of hole through spindle, 25/32" . . . spindle nose diameter and threads per inch, 1½"–8 . . . 12 spindle speeds, 30 to 1450 rpm . . . motor, ⅓ hp, 1750 rpm . . . ball bearing spindle mounting . . . drum type reversing motor switch and cord . . . precision ground ways, 2 V-ways and 2 flat ways.

ABSORBS VIBRATION, GIVES LOGAN LATHES MAXIMUM SMOOTHNESS AND ACCURACY IN OPERATION

Rubber cushioning of the countershaft is one of the unique design features which help make Logan Lathes outstanding in smooth, accurate operation. At no point on the Logan Lathe is there a direct metal-to-metal contact between countershaft and headstock. At all three of the countershaft's main support points, the pedestal rod and the two hinge pins, rubber cushions effectively absorb motor vibration. The result is a maximum of smoothness in operation that is conducive to fine precision work. For details on all the Logan advanced design features, see your nearby Logan Lathe dealer, or write direct for Logan Lathe catalog.

K-2

LOGAN ENGINEERING CO. CHICAGO 30, ILLINOIS

● The realization of this fact has apparently been quite a shock to a lot of salesmen and manufacturers who have been riding through the "tunnel of love" these past few years... totally oblivious to the idea that *it couldn't last forever.* This "writing on the wall" has been clearly visible for many months now, but apparently, many people can't read, or if they can, refuse to believe what they see.

For our part, we welcome the change. We're glad we have to SELL our products... not just make them, crate them and set them on the loading docks. We welcome the return of the good old 100% American competitive method of getting business. If you don't believe it has returned, then watch out, because it will have, before you can throw your hat out of the window.

COME IN WHEN YOU'RE IN BUFFALO

...the "City of Good Neighbors"

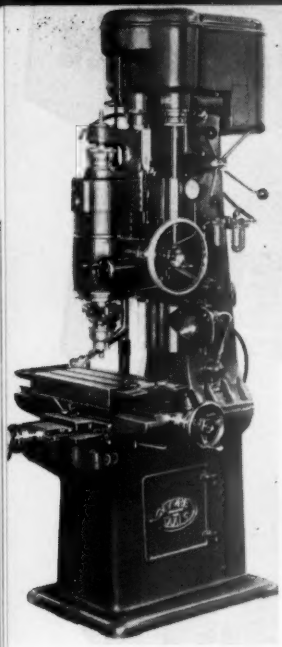
We would like to show you around... help in any way we can to make your visit pleasant. Our offices are right downtown. If it's hotel reservations, wire us, we'll get you in somewhere.

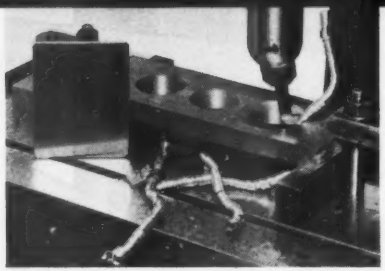
Just as soon as American ostriches... both labor and management... get their heads up out of the sand and go to WORK, just that soon will we all GO PLACES. Then, and only then, will America be able to produce the internal peace and prosperity she is capable of delivering.

K. R. WILSON

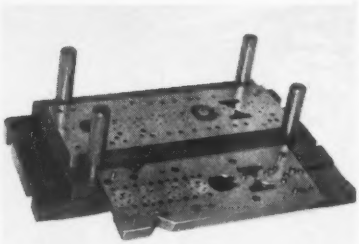
215 MAIN STREET, BUFFALO 3, N. Y.

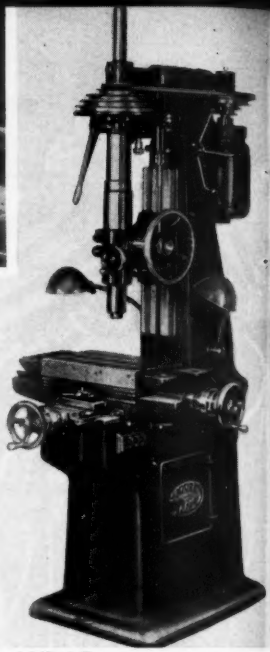
Manufacturers of Hydraulic Blanking, Stamping and Forming Presses.. Hydraulic, Electric and Air-operated Arbor Presses.. Hydraulic Brakes.. Die Try-out Presses.. Stretching Presses.. Complete Automotive Service Equipment.. Industrial Power Units.





Midwest Specialty—Examples of High Precision Die Grinding and Remarkable Range in Jig Boring





Photographs courtesy Moore Special Tool Co.

A Specialty

JIG GRINDING AND JIG BORING

A specialty in a specialists' shop—Midwest's jig grinding and jig boring department is completely equipped to handle the most exacting tooling problems. Skilled craftsmen and modern precision machinery guarantee satisfaction to those accustomed to excellence.

The exceptional accuracy demanded in the design and manufacture of dies, jigs and fixtures is an old story to Midwest Tool & Engineering Co. Our long experience and the best in jig boring and jig grinding equipment is illustrated by the examples of high precision work accomplished at Midwest.

Precise tooling, fair price quotations and dependable delivery combine to produce your jig boring and jig grinding requirements as you would have them in your own plant.

Write Midwest Tool & Engineering Co. today for further information on their specialized manufacture of dies, jigs and fixtures. A prompt quotation will be made where blueprints are included.

TOOLING SPECIALISTS

Midwest

TOOL AND ENGINEERING COMPANY

612-620 Park Avenue • Indianapolis, Indiana

DRILL SIZE PIN GAGES

$1.00 EACH ANY SIZE

Polished Radius Top

TOLERANCE +.0001 —.0000

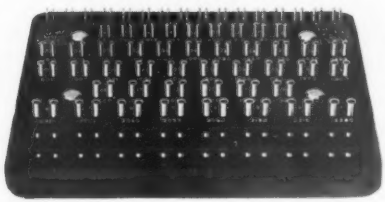
Overall Length 1½"

LOWER HALF TAPERED for easy insertion

Oil Hardened Tool Steel

Flat Ground Bottom

Class Z Accuracy



LETTER SET—52 gages in 26 pairs from A to Z. $45 set.

FRACTION SET—60 gages in 30 pairs in steps of 1/64" from 3/64" to 1/2". $50 set.

NUMBER SET — 120 gages in 60 pairs from 1 to 60. $90 set.

All sets include stands . . . Prices F.O.B. Bridgeport, Conn.

Sets in pairs of gages for checking any number of similar holes. Stands have 3 plates and cover so that gages stand upright. Drill size is plainly stamped in front of each gage hole, together with decimal equivalent to the ten thousandth of an inch.

IMMEDIATE DELIVERY — 116 SIZES

Check or M.O. should include .08c postage for quantities less than Set. Sets shipped Express Collect. No C.O.D.'s.

THE *Horberg* GAGE COMPANY

19 STAPLES STREET, BRIDGEPORT 1, CONN.

PRECISION
REID
SURFACE GRINDERS

PRECISION MANUFACTURING
For 46 YEARS is Your Assurance

"It's Proven!"

The "Know How" experience gained over this long period is built into every REID PRECISION SURFACE GRINDER.

BECAUSE OF

DEPENDABLE ACCURACY,
ECONOMICAL PRODUCTION,
CONTROLS AT YOUR FINGERTIPS,

LEADING SHOP MEN EVERYWHERE SAY,
"for Close Tolerance, use a Reid!"

Illustrated is the REID Model 2-B All-Electric Power-Feed.

The Reid Model 2-C Hand-Feed also is an exceptional machine for tool, gage, die and certain production grinding.

MACHINES EQUIPPED FOR WET GRINDING IF NECESSARY.

EXCELLENT DELIVERIES

Distributors conveniently located in all sections

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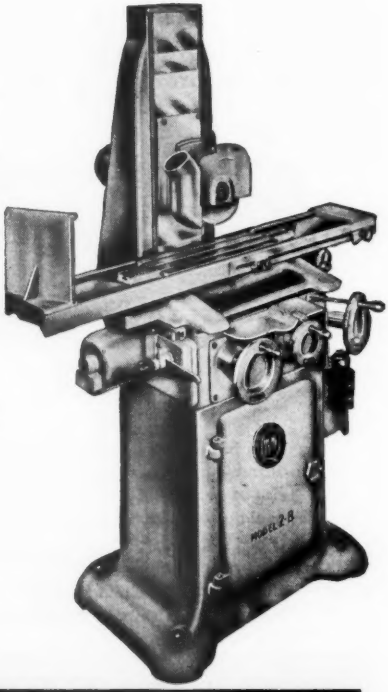
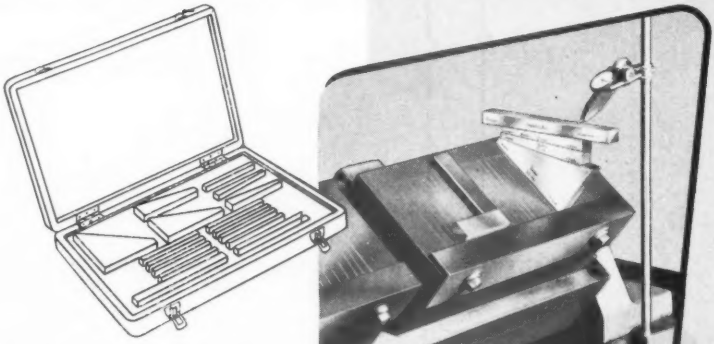
For Illustrated Bulletin and Prices.



REID BROTHERS COMPANY, INC.
BEVERLY MASSACHUSETTS

Fast, Reliable

ANGLE INSPECTION + LABORATORY ACCURACY



Application of Webber Angle Gage Blocks for setting angle on revolving magnetic chuck. Assemble proper combination of blocks that add up to desired angle; mount with parallel and indicate across top of assembly for accuracy.

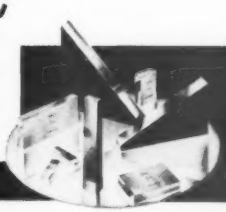
● Fast reliable angle inspection with accuracy beyond the range of traditional shop methods are among the outstanding advantages of the Webber Angle Gage Blocks. Angle Gage Blocks offer an improvement over the sine bar and protractor. No computation other than simple addition and subtraction of angle readings are necessary. An average mechanic can apply the blocks with utter reliability as to results, as the proof is contained within the blocks themselves. Unlike instrument gages no elaborate set up or check reading is necessary as the same results are yielded day after day.

Webber Angle Gage Blocks can be used as master blocks or for routine inspection of fixtures, tools, indexing devices and dividing heads. Steps up speed and accuracy in tooling and production. Ask for bulletin that outlines shop practice.

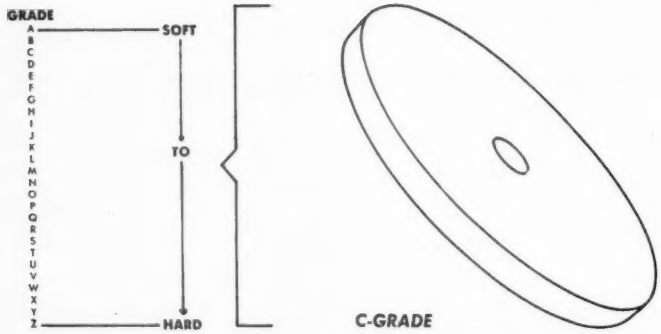
Webber Gage Co. • 12903 Triskett Rd. • Cleveland 11, Ohio

WEBBER MAKES PRECISION GAGE BLOCKS EXCLUSIVELY

- ★ Gage Block Sets in Steps of .00005"
- ★ Individual Special Size Blocks.
- ★ Heavy Duty Gage Blocks.
- ★ Angle Gage Blocks in Steps of one second.
- ★ Carblox (Carbide) Wear Gages.



Webber PRECISION GAGE BLOCKS



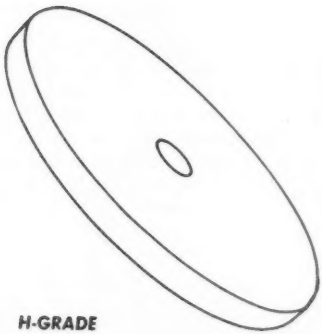
There's more to grinding

The A, B, C's which appear as identification on a grinding wheel help simplify proper grade selection. By clearly showing relative hardness, they make your choice quicker, easier...aid in assuring the right grade for the job. That's one reason wheels by CARBORUNDUM are plainly marked. But, there's more to it than the old chestnut, "the softer the metal, the harder the wheel." It's not that easy.

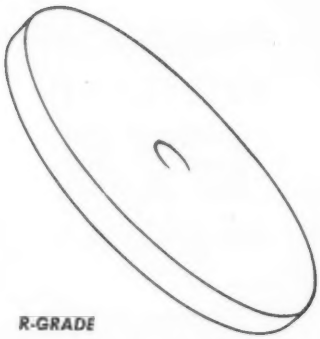
You realize, for instance, that wheel speed itself affects grinding action. The same grade reacts differently at various speeds. The condition of the machine and the amount of vibration can make a difference. Desired finish...required tolerance must be considered. Coolant conditions vary. The actual type of operation—snagging, surfacing, internal grinding or whatever it is—influences practical selection.

Yes—there are many important factors to check before you can be sure of the right grade designation for the job.

A good rule for good grinding... **CALL**



H-GRADE



R-GRADE

grades than the A, B, C's

That's why we suggest consulting your CARBORUNDUM salesman or our distributor's representative. These men work throughout the year on a wide variety of grinding problems. They are familiar with grinding in production... in tool rooms...wherever it is used. They have practical knowledge and experience to help you pick exactly the wheel you need for the job.

Assisting these representatives in the field are our Abrasive Engineers. Specialized experts, they are equipped to analyze uncommon problems...recommend sound solutions. And, here in our modern laboratories are scientists and technicians who are working on the application of abrasive developments to changing grinding practices.

This *three way route* to better grinding is easy to use. No obligations are incurred. Merely talk "grinding" with a CARBORUNDUM representative. He'll be glad to assist you. The Carborundum Company, Niagara Falls, N. Y.

IN CARBORUNDUM

TRADE | MARK

ABRASIVE WHEELS

Silicon Carbide
Aluminum Oxide
Diamond

COATED AND BONDED ABRASIVES

Paper and Cloth Combinations
Sheets, Rolls, Discs
Cylinder Hones
Sticks, Stones & Rubs
Specialties

ABRASIVE GRAINS AND COMPOUNDS

for:
Polishing
Lapping
Pressure Blasting
Finishing

"Carborundum" is a registered trademark which indicates manufacture by The Carborundum Company

PRECISION CENTERED EYE BENDING

with

DI-ACRO BENDERS

DI-ACRO precision bending is accurate to .001" for duplicated parts. DI-ACRO Benders bend angle, channel, rod, tubing, wire, moulding, strip stock, etc. Machines are easily adjustable for simple, compound and reverse bends of varying radii.

Send for Catalog

"DIE-LESS" DUPLICATING

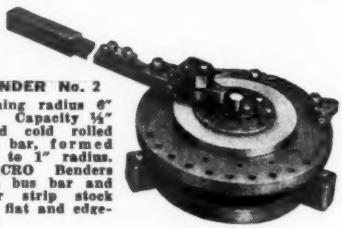
showing many kinds of "DIE-LESS DUPLICATING" produced with DI-ACRO Benders, Brakes and Shears.

A Centered EYE in 1 Operation

The DI-ACRO Bender makes perfectly centered eyes from rod or strip stock at a high rate of production. Both eye and centering bend are formed with one operation. Any size eye may be formed within capacity of bender and ductile limits of material.

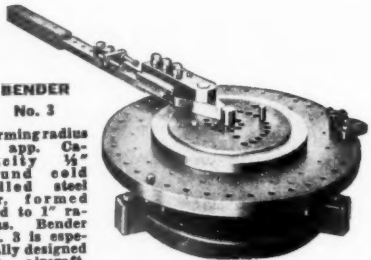
BENDER No. 1

Forming radius 2" app. Capacity 7/32" round cold rolled steel bar or equivalent. All DI-ACRO Benders have two-way action, right or left hand mounting and reversible forming nose.



BENDER No. 2

Forming radius 6" app. Capacity ½" round cold rolled steel bar, formed cold to 1" radius. DI-ACRO Benders form bus bar and other strip stock both flat and edgewise.



BENDER No. 3

Forming radius 9" app. Capacity ½" round cold rolled steel bar, formed cold to 1" radius. Bender No. 3 is especially designed for aircraft, marine and other large radius bending.

DI-ACRO IS PRONOUNCED "DIE-ACK-RO"

DI-ACRO PRECISION MACHINES DIE-LESS DUPLICATING

O'NEIL-IRWIN MFG. CO.

315 Eighth Ave.
Lake City, Minn.

QUIT Making Manual CLAMPING ADJUSTMENTS!

Let the Pressure-Matic Assembly provide automatic compensation for thickness variations in parts being clamped

There may be variations up to ¼ inch in the thickness of work being held—castings, forgings, wood and plastic parts. With a Pressure-Matic Assembly welded to the working bar of your De-Sta-Co Clamp, compensation for each variation becomes automatic. A heavy compression die spring allows the spindle to adjust itself to the thickness of material, always maintaining positive holding pressure. Available in two types, for installation on De-Sta-Co medium and heavy duty Clamps.

SEND FOR the new De-Sta-Co Catalog No. 45. Fully describes the Pressure-Matic Assembly, also complete line of time-saving Clamps.

DETROIT STAMPING CO.

Established Over 30 Years

344 Midland Ave • Detroit 3, Mich.

CHECK
with
BUNELL

It's an organization of men and machines to serve industry in the designing and building of special machines, tools, metal stamping dies, jigs and fixtures.

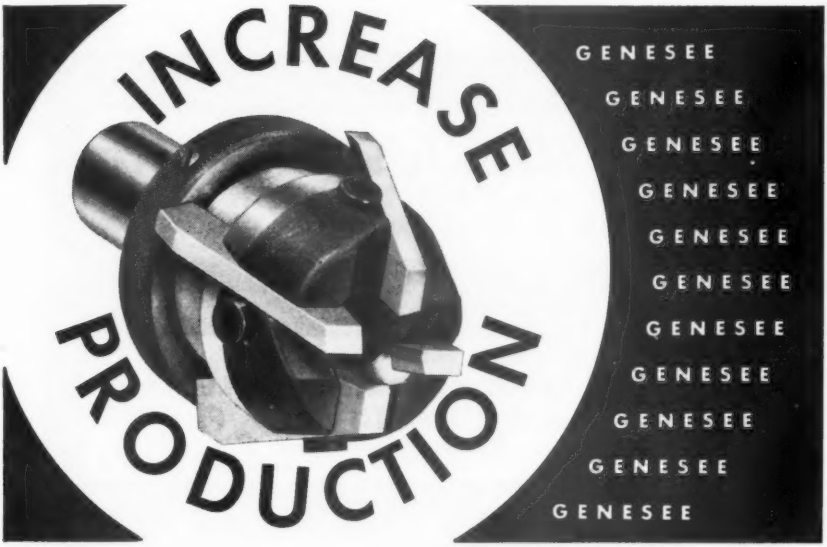
Also, it's an organization that offers an economical engineering check-up service made by technical men to review equipment and processes in the individual plants of customers—a man-Friday service of simplification and help.

It's an organization geared, also, to precision production of contract manufacture of parts and assemblies.

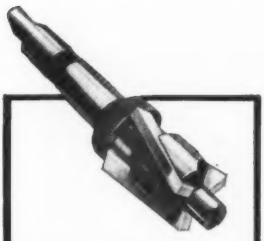
The BUNELL Machine & Tool Company

1601 East 23rd Street

CLEVELAND 14, OHIO



ADJUSTABLE HOLLOW MILLS



Other Genesee tools that will increase production.

•

Inserted Blade FACING AND COUNTERBORING TOOLS

•

SPECIAL PRODUCTION TOOLS

There is a Genesee for every hollow milling job. Available in 16 styles. Standard sizes from 0 to 2", with straight or Morse taper shanks carried in stock . . .

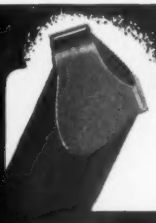
- Each size tool has 1/8 range.
- Blades quickly ground in a simple fixture.
- All tools manufactured of heat-treated alloy steel.
- Adjusting threads are ground from the solid and adjusting rings are lapped for extreme accuracy.
- Furnished with high speed steel, cast-alloy, or Tungsten Carbide tipped blades.

Let our Engineering Department solve your Production Tool problems.

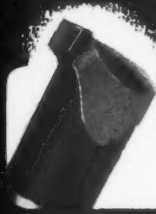
GENESEE MFG. CO., INC.
GENESEE
EST 1908
ROCHESTER 4, N.Y.

Write for catalog 45-J

ADJUSTABLE HOLLOW MILLS • FACING AND COUNTERBORING TOOLS • SPECIAL PRODUCTION TOOLS



Use this for
GENERAL BORING and for BORING THROUGH HOLES
Boring diameters from 3/32" up
Known as STYLE A



Use this for
BORING BLIND HOLES and BOTTOMING AND FACING
Boring diameters from 3/16" up
Known as STYLE B

Use this for
INTERNAL THREADING
Thread diameters from 1/4" up
Known as STYLE C

Because the design of all Bokum Boring and Threading Tools provides a helical relief that assures constant clearance angles throughout entire life of tool—reducing the necessity for resharpening to only one face and thus reducing down time—these tools are regarded as "tops" in all shops where high production is sought. Finish lapped cutting surfaces produce better bores with faster feeds.

Send for folder describing new holder with quick, simple vertical adjustment.

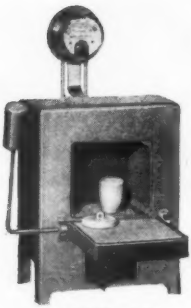
Send for catalog showing all these efficient tools—ask for E-1139 for super high-speed tools and E-398 for carbide tipped tools.

TRADE MARK REG. U. S. PAT. OFF.

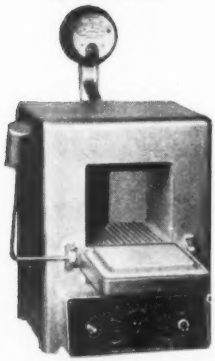
BOKUM TOOL CO.

14775 WILDEMERE AVE. · DETROIT 21, MICH.

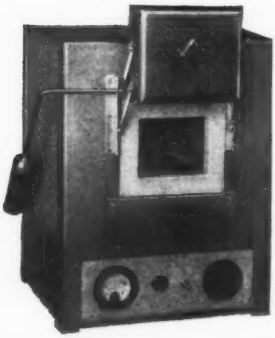
SINGLE POINT BORING TOOLS—INTERNAL THREADING, BOTTOMING AND FACING TOOLS—CARBIDE TIPPED TOOLS



MODEL GTP



MODEL CEA



MODEL OFE

TEMCO

ELECTRIC FURNACES

With the new TEMCO stepless control you can select and hold any desired temperature.

Model GTP—interior 4" x 3¾" x 3¾". May be operated continuously up to 1500° F. and intermittently to 1850° F. Embedded heating element. Power consumption 1.2 kw. Cast aluminum body. Weight 15 pounds.
For 115V A.C.....**Price $57.50**
Also available for 230V and D.C.

Model CEA—interior 4¾" x 4¼" x 6". Maximum continuous temperature 2000° F. Element is embedded for its protection and surrounds muffle chamber for uniform heating. Power consumption 1.5 kw. maximum. Insulated aluminum body. Weight 31 pounds.
For 115V A.C.....**Price $80.00**
Also available for 230V and D.C.

Model OFE—interior 6" x 5" x 10". Maximum temperature 1600° F. continuous, 1900° F. intermittent. Synchronous motor driven control. Heating element covers four sides of chamber. Steel frame with 4½" insulation. Maximum power consumption 2.2 kw. Weight 130 pounds.
For 115 or 230V A.C.....**Price $194.00**

TEMCO furnaces have low initial cost and are economical to operate as nearly all the power is consumed within the heating chamber. They are fast heating and ideal for general laboratory uses, heat-treating and small unit production.

See your supply house or write for literature giving detailed specifications

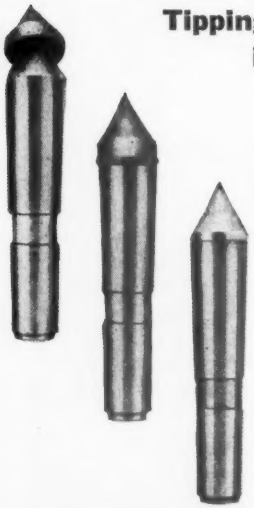
474 WEST LOCUST ST., DUBUQUE, IOWA

THERMO ELECTRIC
MANUFACTURING COMPANY

Use COLMONOY CENTER TIPS

With COLMONOY CENTER TIPS You Can

- ✓ Get more than five times as many pieces per grind as with hardened tool steel centers . . .
- ✓ Salvage your worn centers . . .
- ✓ Cut new center costs by tipping cold rolled steel blanks . . .



Tipping Centers with COLMONOY is Economical and Fast

A Colmonoy tip for a No. 4 Morse, for instance, costs only 98c.

It can be applied in 10 minutes. Only ¼ oz. of silver solder is needed.

We will furnish you the tips—or apply them for you. Write for Bulletin CT-1, giving full information as to sizes and prices.

WRITE FOR CATALOG 76

Covers the complete line of Colmonoy Hard Facing Alloys, and illustrates typical applications.

WALL COLMONOY CORPORATION

7TH FLOOR FISHER BLDG., DETROIT 2, MICH.

Blanking
Forming
Pelleting
Shearing
Marking
Assembling with MULTIPRESS

MULTIPRESS with HydrOlLic Indexing Table

MULTIPRESS with Pelleting Attachment

ON SCORES of jobs like these—and many others—MULTIPRESS users continue to report higher production, increased efficiency and better results.

The reason: remarkable operating flexibility has been built into the highly compact, fully self-contained *basic* MULTIPRESS—and its flexibility has been further multiplied by an unusually wide range of standard MULTIPRESS controls, toolings and accessories.

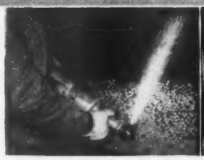
In addition, Denison research engineers work constantly to find better ways to apply MULTIPRESS advantages to specific operations of every kind.

Basic 4-Ton MULTIPRESS (also 6 & 8 ton capacities)

MULTIPRESS offers a choice of 4, 6, or 8-ton units . . . seven different models . . . manual or automatic controls . . . accessory benches, work-table extensions, side shelves and bolster plates . . . attachments for indexing, pelleting, foil marking, etc. . . . toolings for almost any need. Write for full details. The Denison Engineering Company, 1197 Dublin Road, Columbus 16, Ohio.

DENISON EQUIPMENT for APPLIED HydrOILics

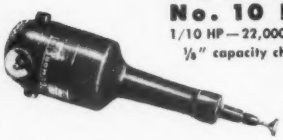
DUMORE
No. 9 HG
¼ HP — 15,500 RPM
¼" capacity chuck



Spark-Testing Steel

Cleaning Welded Joints

DUMORE
No. 10 HG
1/10 HP—22,000 RPM
⅛" capacity chuck



Touching-Up a Forging Die

De-Burring Gear Teeth

DUMORE
No. 8 HG
1/20 HP—18,000 RPM
⅛" capacity chuck

Automatic De-Burring Unit

Finishing Plastic Mold

YOU can do an endless variety of jobs with a sturdy, serviceable Dumore Handgrinder

Its rugged durability guarantees efficient, trouble-free service

When you have a job that requires a good handgrinder, select a Dumore. Grinding is only the first of many jobs you can do with these versatile tools. They have scores of other applications (a few illustrated on this page) — polishing, finishing, sanding, burring, scoring, touching up, drilling, milling, and many more.

Dumore Handgrinders are more than just hand tools. Many ingenious users have built special machines in which the work heads are one or more Dumore Handgrinders. Such machines are reliable, low-cost production units requiring minimum maintenance attention.

Ask your nearby distributor to recommend the right size for your needs. Write for complete information. The Dumore Company, Racine, Wis.

TEAR OUT AND MAIL COUPON TODAY!

FREE — Catalog 42

THE DUMORE COMPANY, Dept. L-42
Racine, Wisconsin

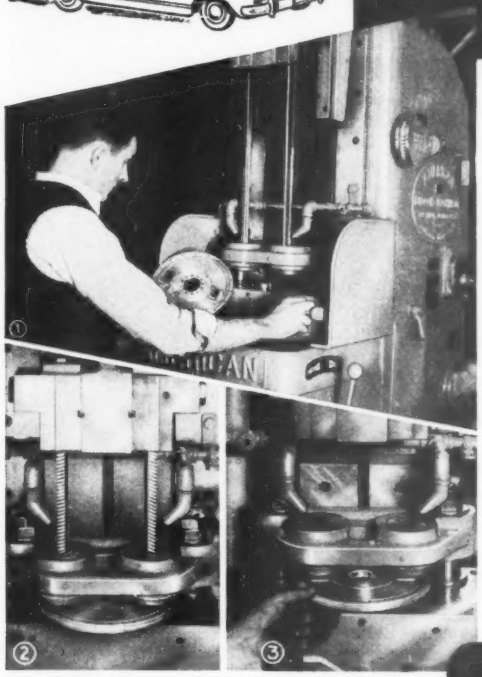
Please send without obligation, Catalog 42, describing your complete line of tools and grinders.

Name_____ Position_____
Company_____
Address_____
City_____ (__) State_____

DUMORE
PRECISION TOOLS

G-38

BUILT BETTER
Because of
BROACHING BY
American



AMERICAN has designed and built broaching equipment to help form an endless procession of automotive parts. Among the countless pieces manufactured with the help of *American* broaching machines are transmission, steering, generator, differential, hydraulic, ignition, and brake parts, cams, cylinder blocks, gears, and connecting rods.

American's service to industry is three-fold. *American* makes broaching machines and broaching tools; *American* engineering talent is at your service to devise the means of making this equipment useful to you. Write today for further details.

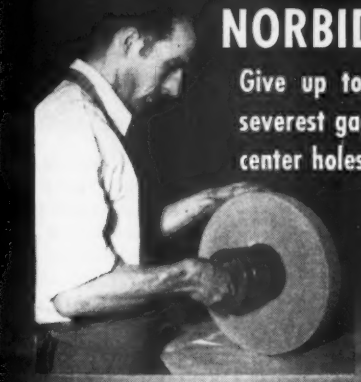
A typical job, performed on a standard *American* T-6-24 broaching machine, is broaching three sides in each of two holes of a diaphragm mounting plate. **Fig. 1** shows the operator about to load and clamp the part in the fixture. Broaches are at upper end of stroke. **Fig. 2** illustrates the machine midway in the broaching cycle. **Fig. 3** shows the part automatically ejected at the end of the broaching stroke. Broaches are returned to "up" position before next part is loaded. The complete cycle takes less than 30 seconds, including loading and unloading.

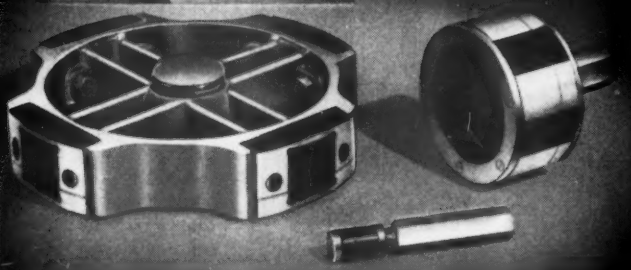
MEMBER BROACHING TOOL INSTITUTE

American
BROACH AND MACHINE CO.
ANN ARBOR, MICHIGAN
•
BROACHING MACHINES
PRESSES
BROACHING TOOLS
SPECIAL MACHINERY
DIVISION OF

NORBIDE GAGES

Give up to 200 times longer life on severest gage-wearing job—measuring center holes in grinding wheels.





NO job could be a more severe test of the wear-resistance of gages than that of measuring center holes in grinding wheels. Not only do the hard, sharp grains of abrasive cause an abrasive action as the gage is inserted in the grinding wheel, but also the manufactured abrasives, aluminum oxide and silicon carbide, are themselves harder than many of the metals commonly used on measuring devices. Here, as in many production measuring jobs, is the place to use NORBIDE gages, manufactured of Norton Boron Carbide, the hardest material made by man. The extreme hardness of NORBIDE gages enables them to outwear many other types of gages hundreds of times and eliminates the costly, time-consuming requirement of frequently checking gages for accuracy.

NORTON COMPANY, WORCESTER 6, MASS.

NORBIDE* – The Hardest Material Made by Man

NORTON BORON CARBIDE

*Trade-mark Reg. U. S. Pat. Off.

Automotive Maintenance Machinery Co.

2100 COMMONWEALTH AVE. AMMCO NORTH CHICAGO, ILL.

Announces

A Change of Name to

AMMCO TOOLS, INC.

COMMONWEALTH AVENUE AMMCO NORTH CHICAGO ILLINOIS

Automotive Maintenance Machinery Co. of 2100 Commonwealth Avenue, North Chicago, Illinois, has changed its name to AMMCO TOOLS, INC.

No change in organization, management, personnel, or company policy has been made.

The old name was too long, and did not adequately describe its products. For the convenience of the trade, the familiar "AMMCO" Trade Name has been incorporated in the new company name.

The company continues to manufacture its famous line of AMMCO Tools and will shortly announce a number of important new tools to the Automotive, Mill Supply and Machine Tool Industries.

Future inquiries and correspondence should be addressed to the company under its new name: AMMCO TOOLS, INC., Commonwealth Avenue, North Chicago, Illinois.

HEAT TREAT SMALL PARTS

In Your Own Plant

SAVE TIME AND MONEY

With these Versatile Cooley Furnaces

- One model to operate to 2000° F.
- One model, 2 sizes, to heat to 1850° F.
- Use for both hardening and tempering.
- Simple and economical to operate.
- Positive control over high and low heats.
- Uniform temperatures assure results.

Power Cost Less Than 4 Cents per Hour

To hold 1600° F. in the MH-3 furnace requires less than 2 kw. At power rate of 2c per kw.-hr., operating cost is under 4c per hour. Cooley furnaces are easily installed—ready for immediate service by connection power lines to two terminals. Replaceable heating elements are embedded in refractory materials, protecting against atmospheric attack. Quiet in operation—no fumes or odors—no ventilating necessary—they can be located at any convenient place in the shop.

ESSENTIAL FOR TOOL AND DIE SHOPS

More Profitable Reasons for Using Cooley Furnaces

1. Hardening, drawing and tempering small batches.
2. Small parts can be normalized and annealed quickly and easily.
3. Convenient for high speed pre-heating.
4. Expedites emergency repairs.
5. Use as a pilot furnace to pre-determine production heat-treating technique.
6. Harden and draw in the same furnace with assured temperature control at either heat.

TWO NEW OPTIONAL FEATURES AVAILABLE

1. Counter Weighted Vertical Lift Door conserves heat where door need not be fully opened. Replaces hinged hearth door at $20.00 additional on MH-3, MH-4—standard on MH-5.

2. Heavy Gauge Steel Stand—For ease of installation and operation—locates furnace at most convenient operating height and provides additional working and storage space. Add $35.00 to regular price.

THREE SIZES—MH-3, MH-4—1850° F. MH-5—2000° F.

Type	Chamber Capacity	Amps 115 V	Watts	Amps 230 V	Price
MH-3	8"W 6"H 14"L	29.6	3400	14.8	$146.00*
MH-4	10"W 6"H 18"L	.....	4500	19.6	$222.50*
MH-5	8"W 6"H 14"L	.....	4800	20.9	$340.00*

*All furnaces complete with Hearth Plate.

Automatic Control—Indicating Controlling Pyrometer—Thermo-couple and lead wire—approximately $150.00

FREE!

HEAT TREATING HELP

Our experience in heat-treating is available to you. State your problem . . . write for Bulletin No. 56 today—no obligation. No salesman will call.

COOLEY ELECTRIC MANUFACTURING CORP.
32 South Shelby Street Indianapolis 7, Indiana
INDIANAPOLIS MACHINERY EXPORT CORP.
Export Manager, 44 Whitehall Street, New York, New York

More Speed...
LONGER DRILL LIFE with CONTINENTAL'S *New* DRILL CHIP BREAKER

Faster drilling action and prolonged tool life are but two of many advantages obtained with the Continental Drill Chip Breaker. By breaking chips into small, uniform pieces that are easily carried up the flutes of the drill, clogging is eliminated. The unit can be used vertically, horizontally, or at any angle as long as the housing can be kept stationary while the drill rotates. The arm prevents rotation of the housing. Where space permits, the Continental Drill Chip Breaker can be used in multiple spindle heads. ***Write for Continental Bulletin 28161 for sizes, complete specifications and 7 ways to profit by this new Continental product.***

With the Continental Drill Chip Breaker, the chip is broken at regular intervals. Small loose chips are easily carried up the flutes. Holes are straighter, rounder, and have better wall finish.

46—51

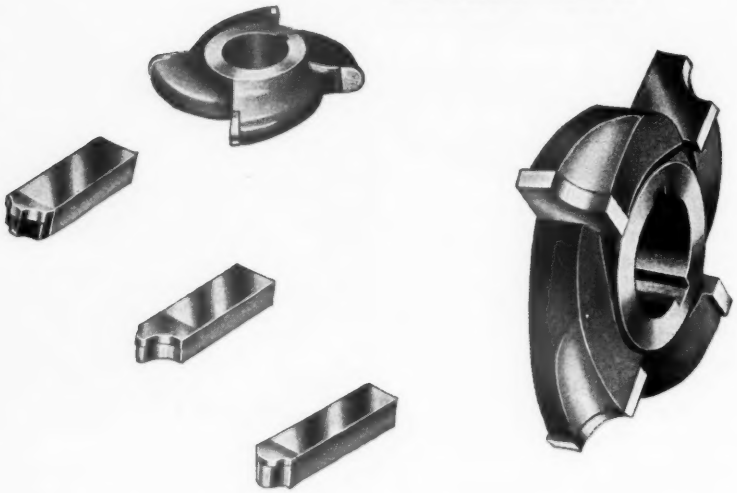
CONTINENTAL TOOL WORKS

DIVISION OF EX-CELL-O CORPORATION

1200 OAKMAN BOULEVARD • DETROIT 6, MICHIGAN

STEP UP PRODUCTION 500%

With Meyers Carbide Tipped Formed Tools



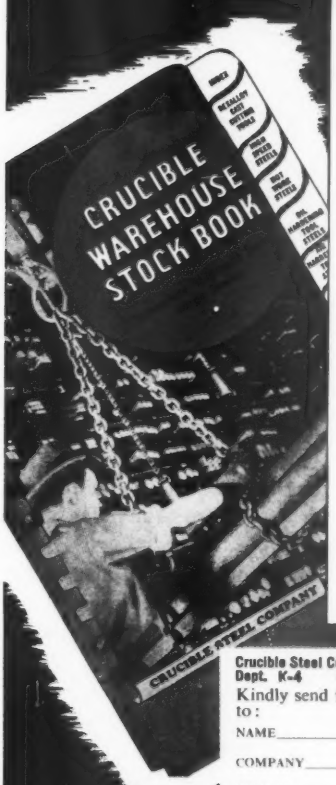
On actual production runs, Meyers generated Carbide Tipped Tools have boosted production more than 500%.

This amazing increase was due to use of special Meyers equipment designed and engineered by our Engineering Department. Increased costs force you to get the most out of your machine tools—Meyers generated carbide tipped form tools will give you more pieces per hour—more pieces between grinds—and a much smoother finish. Let us help you improve your production and cut your costs. Send us your prints for quotation.

W. F. MEYERS COMPANY, INC. • *ESTABLISHED 1888*

1016 FOURTEENTH STREET • • • BEDFORD, INDIANA

FREE HANDY STOCK BOOK



New Book Lists Crucible's FULL RANGE of Specialty Steels
HIGH SPEED • ALLOY • STAINLESS
MACHINERY • TOOL
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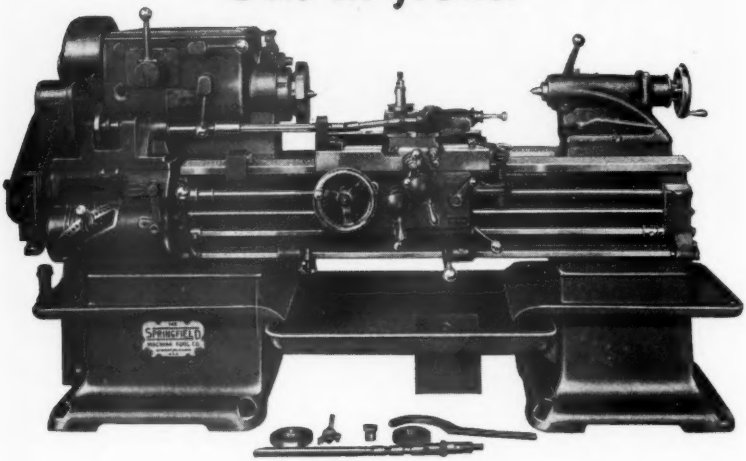

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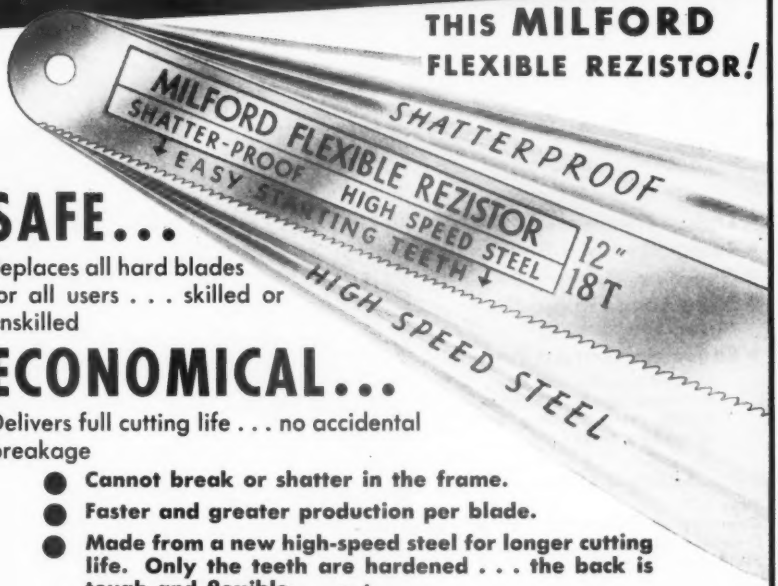

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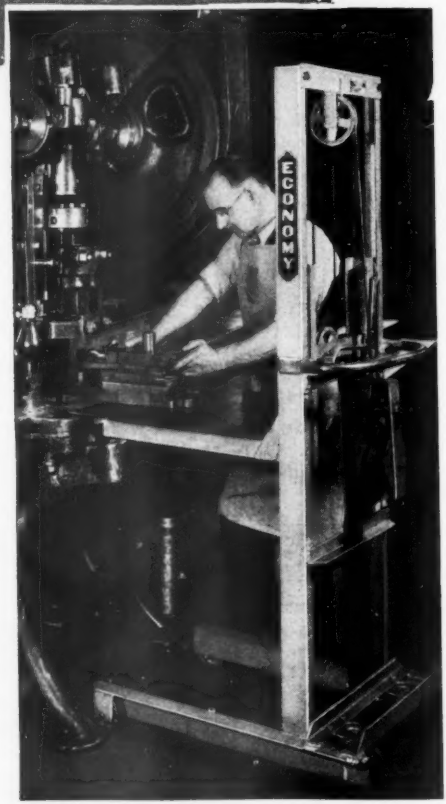

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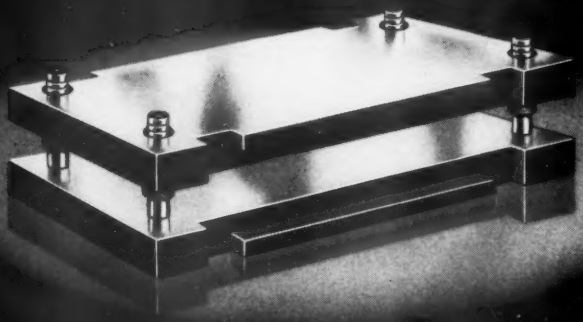

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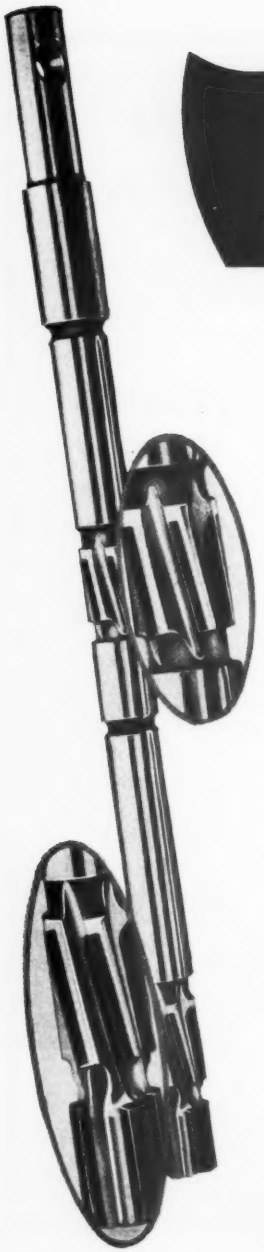

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AGAIN, Detroit Reamer & Tool Company sets the pace in metal cutting tools, with brazed carbide tips on hardened high-speed steel bodies, so that the total length of the flutes and pilots will Rockwell C-62-63.

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To speed production and reduce scrap losses, a prominent bicycle manufacturer sought a low-cost method of doing a faster, better rim-piercing job. The difficulties presented were the too-limited size of existing equipment, the accurate hole requirements, and the necessity for speeded-up volume production.

Barth Engineers developed the answer, with this foolproof Barth-designed and Barth-built die, completely air-operated in a single compact unit which pierces all rim holes in one automatic operation.

Production was stepped up in three cost-saving ways: (1) the unit moves into the production line and speeds output many times that of former methods, (2) the scrap losses are entirely eliminated, and (3) the simplified operation holds accuracy well within the manufacturer's requirements.

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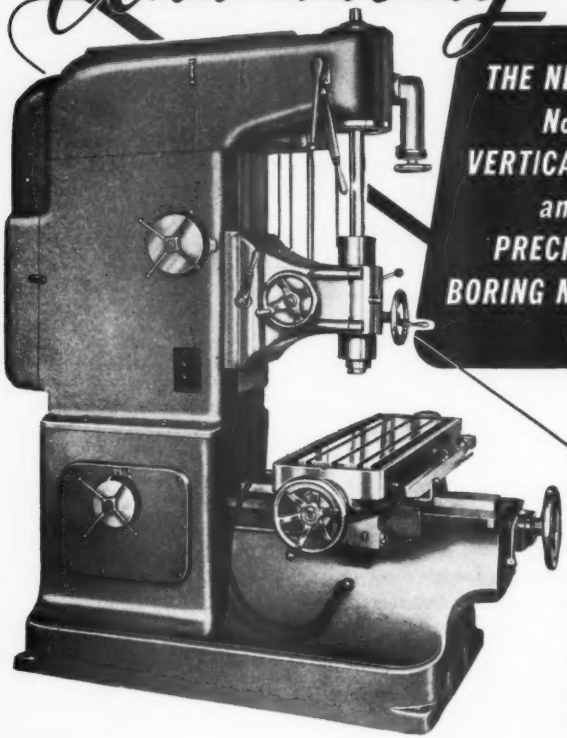

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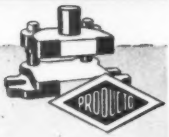

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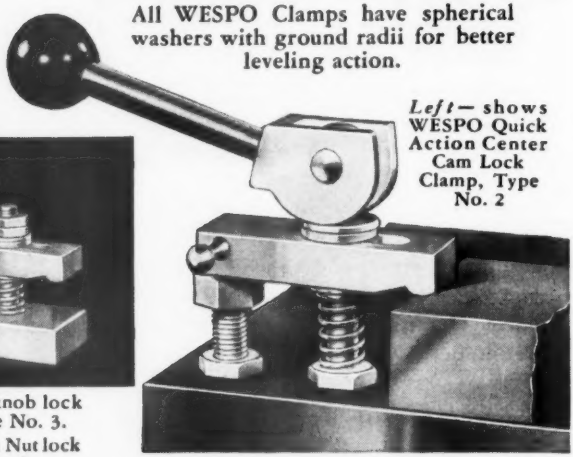
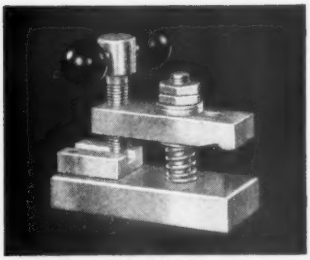
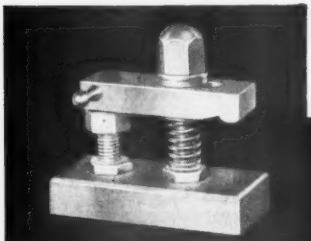


Left— shows WESPO Quick Action Center Cam Lock Clamp, Type No. 2



Above—End knob lock clamp. Type No. 3.
Below—Acorn Nut lock Type No. 5



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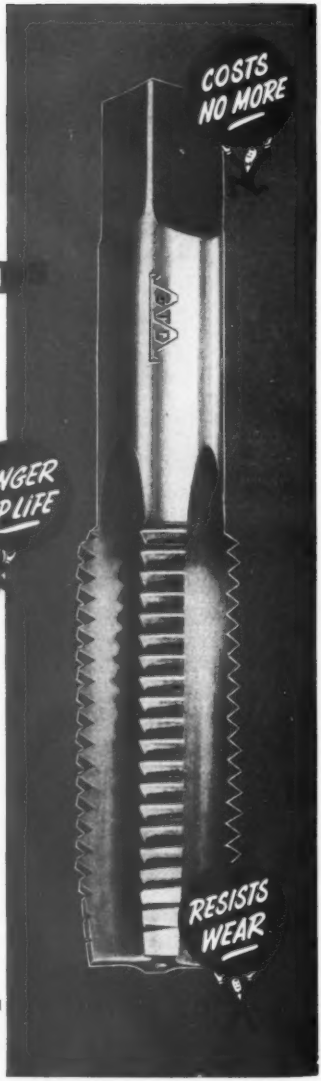

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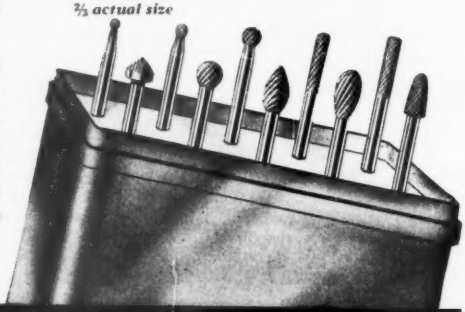

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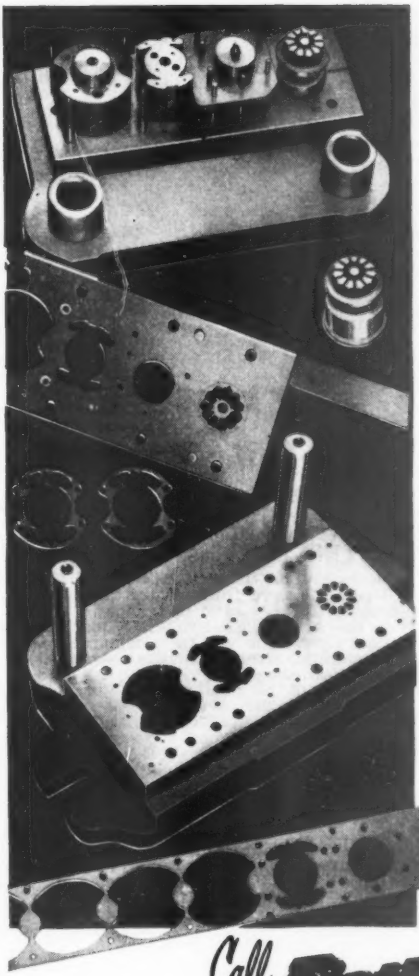

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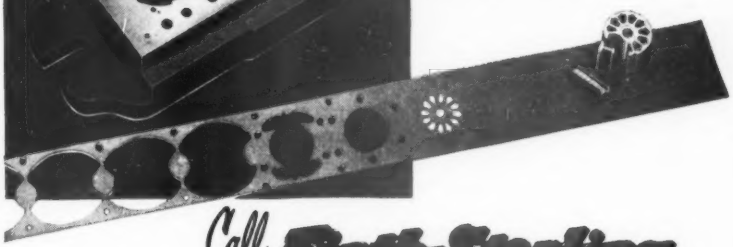

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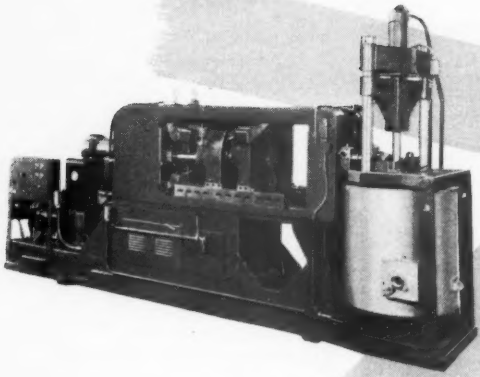

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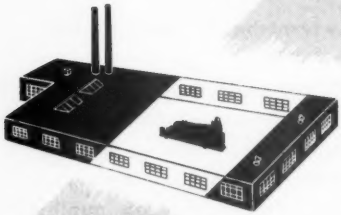

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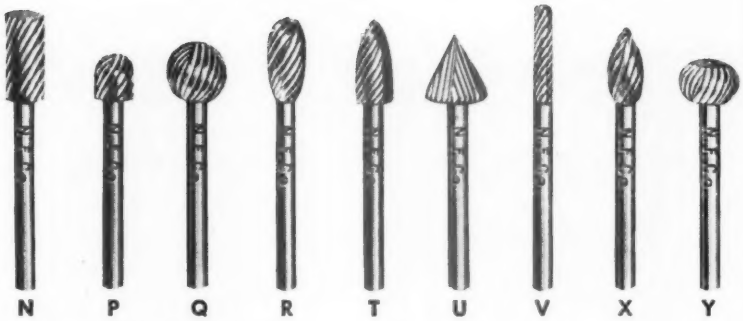

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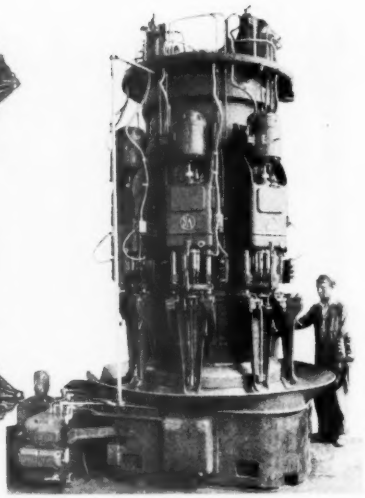

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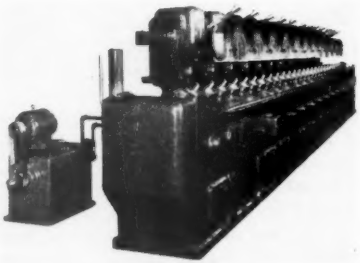

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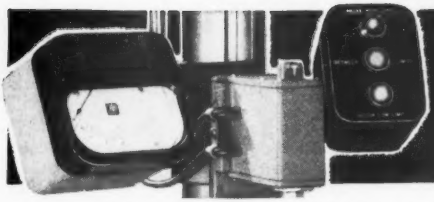

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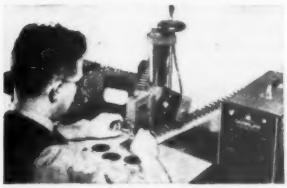

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PRECISION MEASURING INSTRUMENTS

We, of the Tool & Die Journal Staff,
are most appreciative of the
encouragement, help and cooperation
that we have enjoyed throughout the year from
our Readers, our Advertisers and
their Agencies, our Printers, Engravers
and Electrotypers and our Postal and
Express friends.
Again, to one and all, we sincerely wish a very

Merry Christmas

a very prosperous and

Happy New Year

E. Willard Pennington

editor

Quality Control Of Automotive Valve Line Production*

The application of statistical control procedures to line production may best be illustrated by a specific example. The examination of the procedures, results, and experience gained in a particular case may then be used to illustrate the general principles of a line production quality control system.

The example used for this purpose is taken from the plant of the Thompson Aircraft Products Co., and deals with the manufacture of automotive valves. These valves are produced in a line, where the product moves from operation to operation without backtracking, and in a continuous production stream from start to finish. This is a typical example of comparatively simple straight-line mass production of an article of high precision.

by E. F. Gibian
Chief Industrial Engineer
Thompson Products, Inc., and
Thompson Aircraft Products Company
Cleveland, Ohio

The setting up of these production lines had to be started almost overnight after V-J Day and completed in a very short time. The hurried move necessitated by this change-over from war production to peace-time production was naturally accompanied by considerable confusion, and the efficiency of these lines at the start of production was, of necessity, very low. It became immediately apparent that steps had to be taken to raise the efficiency of these lines by an intelligent industrial engineering approach. The objectives of this approach were to reduce the cost of direct and indirect labor, especially inspection; to improve machine utilization; to reduce the inventory in process; to reduce the repairs and scrap; and to raise the quality level of the product and the quality-mindedness of the entire working force.

To accomplish these objectives, provisions had to be made to obtain revealing and accurate performance data so as to establish good manufacturing control based on concise and accurate reports. The installation of daily budgetary control reports became imperative and was one of the first steps initiated in the

*A paper delivered before the Midwest Quality Control Conference, Chicago, March 6, 1946. Presented here by courtesy of Martin A. Brumbaugh, Editor "Industrial Quality Control", and the author.

industrial engineering program. As soon as this was accomplished, the need for the second step became apparent; namely, the need for statistical control of the process.

Figure 1 illustrates a typical valve forging as it is delivered to the start of the valve machining line. It is made from a heat resisting alloy steel which is not readily machinable, and particular care and ingenuity are required in developing the tooling and various fixtures used in the subsequent machining operations.

Figure 2 illustrates the finished product made from such a forging. The seat, stem, and face of the stem are ground; the balance of the surfaces machined. The two grooves near the end of the stem are the retainer grooves for the valve lock. They have to be accurately located in relation to the seat; and the seat, stem, retainer grooves, and stem face have to be concentric and square to each other, as applicable, to rather close tolerances.

The progress of the product from operation to operation is shown in schematic fashion in Figure 3, which illustrates the main steps.

Formulation of a Quality Control Program

When the production on this line was started, as many as 30% of the valves flowing through the line had to be returned for repairs at one point or another. The percentage of rejects at final inspection was excessive. When the cost of inspection was analyzed, these figures also were discouraging. A closer examination of inspection procedures disclosed that efforts were often misdirected, and that the inspection results were in no way commensurate with inspection efforts. A plan for improving quality control was therefore formulated, and the quality control group was given the following assignment:

1. Study each operation in a line from the quality control standpoint.
2. Wherever feasible, apply statistical methods to chart the frequency distribution in order to determine if this particular operation is, or may be, brought under control. At the same time, analyze the distribution of the present inspection force, and estimate inspection savings if statistical quality control could be made effective.
3. Collect accurate records of all rejects, scrap, and reworks by operations and by operators.
4. Study the effect of out-of-control conditions on subsequent operations in the line, and point out difficulties which may be caused by such conditions.
5. Study current manufacturing tolerances, and analyze the effect of these tolerances on the particular operation to which they apply and on subsequent operations.
6. The quality control group is to be given full authority on one machining line. Control chart procedures are to be installed, and the quality control department will have the authority to call for tool adjustments and methods changes wherever indicated. The quality control group will also have authority to redistribute or reduce inspection personnel as control chart procedures are installed.
7. Relate and co-ordinate the activities of the quality control group with standard engineering and the budgetary control program.

This last point may sound rather un-

Fig. 1.
Valve forging.

Fig. 2.
Completed valve.

usual, but it is a very important step because quality control should be concerned not only with the quality of the product, but also with any cost reduction program. Labor standards are established on the basis of existing conditions. When statistical control is applied, it very often brings about such radical changes that standards must be adjusted accordingly if full benefits are to be derived from the activities of the quality control group.

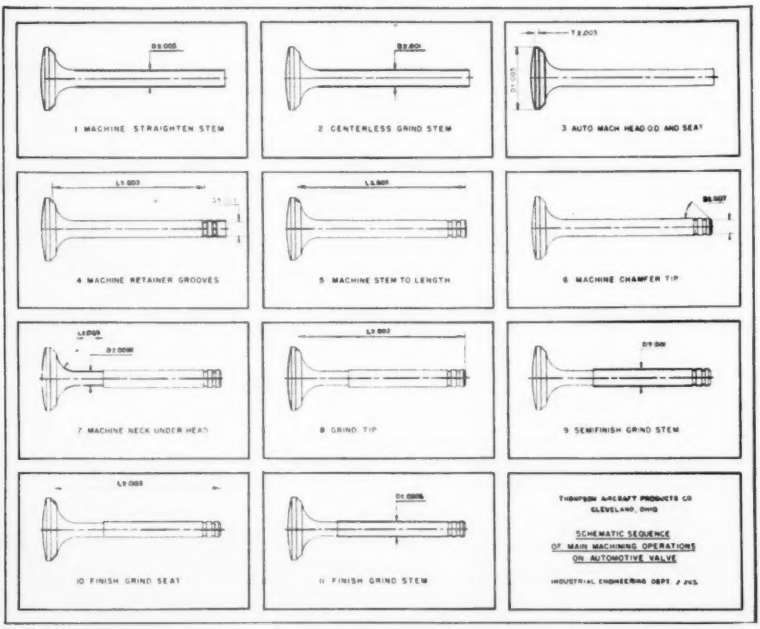
Daily budgetary procedure should reflect any accomplishments obtained by the installation of successful quality control methods. Factors used in a budgetary control system are therefore adjusted according to the progress made by the quality control program. The amount of operating labor is budgeted and related to the number of setups, inspection supervision, inspection labor, replacement tools, grinding wheels, and other items. Any improvements in the use of direct labor, inspection, tools, and grinding wheels (to cite a few examples) call for the adjustment of budget factors to reflect the changed conditions. By such a tie-in of the quality control work with the functions of other departments concerned with the operating efficiency of the plant, quick and permanently good results are obtained.

Preliminary Findings

Studies were made on each operation in the valve line under existing conditions, results were charted, and all pieces were 100% inspected. As soon as data were assembled, and averages and ranges determined, control chart procedures were installed. Quality control engineers directed tool adjustments and methods changes, and the results were again checked by 100% inspection. When any particular process was reasonably well under control, a regular control chart procedure was established and turned over to the inspection personnel, although the quality control department kept a constant check and continued to give advice.

The preliminary findings of this survey revealed that the majority of the operators ran towards the high side to avoid scrap; they played safe. This practice was the source of too many reworks and repairs. Especially, inexperienced help had the natural tendency to stay on the safe side, and results obtained from sev-

Fig. 3. Sequence of operations in the line.



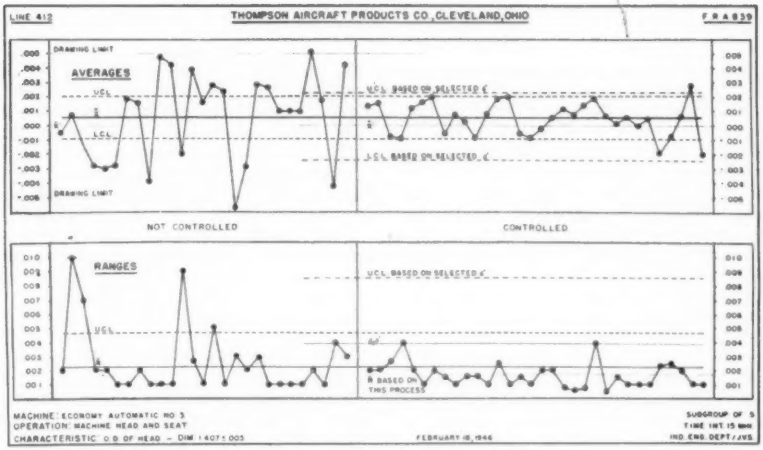


Fig. 4. Control chart for operation No. 3.

eral machines used on the same operation were, therefore, very erratic and caused frequent interruptions or delays in the progress of the work through the line. The improvement of this condition, and the almost total elimination of these difficulties, will be brought out later by comparing the conditions existing before the various processes were brought under control with the conditions existing after statistical control was established.

Statistical Control of Individual Operations

The first operation of roll straightening the valve forging is not covered by a control chart procedure. Operation No. 2, rough grinding the stem on a centerless grinder, is similar to the finish grinding operation, No. 11, and the results obtained on all three centerless grinding operations will therefore be illustrated by the example given for operation No. 11.

The machining of the circumference and the seat of the head is done on a single spindle automatic. Pieces are fed from a hopper to an automatic feed which inserts the valve in the chuck. Tools on the front and back slide perform the machining operations, and the valve is automatically ejected when the cycle is completed.

The left portion of the control chart, Figure 4, illustrates the performance of one of these machines before the control chart procedure was applied. The average was fairly close to the drawing mean, which is indicated by $\bar{x}'$. The average range was satisfactory, but it can readily be seen that the process was not under control, and that the operator did not know when or how to make his tool adjustments in order to keep the pieces within the specified tolerances. Consequently, many pieces had to be reworked, as indicated by the points above the upper control limit, and a considerable number of pieces became scrap, as indicated by the points falling below the lower control limit. The right-hand portion of the chart clearly illustrates the marked improvement obtained by the control chart procedure. Although the mean average, $\bar{\bar{x}}$, is slightly above the drawing mean, both ranges and averages are well under control.

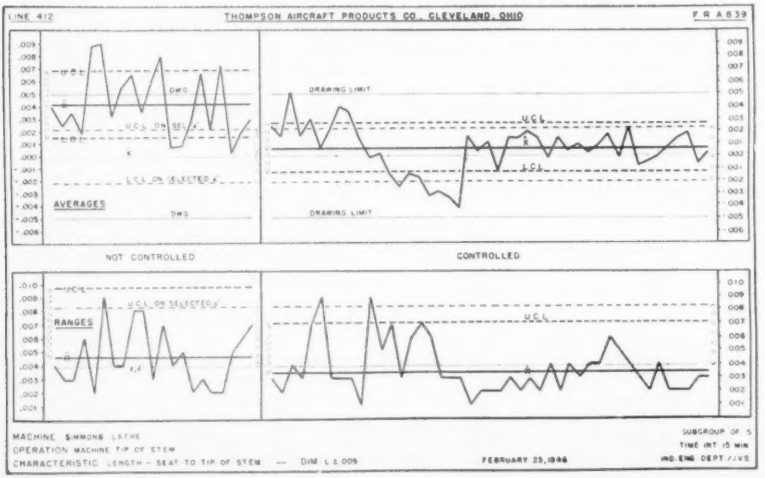
As an additional help in appraising the process, the mean range, based on a selected σ', is shown on the chart. The selected mean range is indicated by the line $d_2\sigma'$, and the corresponding upper and lower limits for averages, based on the selected σ', provide an auxiliary method for judging how this process fits the drawing specifications. This chart shows the record from one machine, but several machines are used on the line for the same operation. After bringing all the machines under control by the control chart method, the 100% inspection previously necessary was eliminated, and the high percentage of repairs also disappeared.

The machining of the retainer grooves is a very fast operation, performed on a single-spindle Brown & Sharpe automatic. It requires only loading and unloading of the valve. Originally, one operator ran one machine and inspected all the valves on a "go" and "no-go" gage. When the statistical studies disclosed that the process stayed in control, a modified statistical control was established by providing the operator with an additional set of gages set to the upper and lower limits of the process for individual pieces. The operator now checks the first twelve pieces after each setup, and from then on he checks approximately every fiftieth piece on the control limit gage. It thus became possible to assign two machines to each operator and obtain considerable savings.

Machining the stem to length, operation No. 5, is done on a conventional screw machine provided with a fast loading fixture. Several machines are in the production line, and the accuracy of the process depends, to a certain extent, on the trained "feel" of the operator because the tool slide is moved by hand. Figure 5 again illustrates the conditions before and after statistical control was established. It can be seen that the rather inexperienced operator stayed on the safe side, his average running approximately .004" above the drawing mean. The average range was too far above the selected $d_2\sigma'$. After the control chart was put into use to bring the process under control and help the operator to acquire the correct technique, an entirely different picture developed, as shown in the right-hand portion of the chart which illustrates the process coming under control. The average was brought very close to the drawing mean, the range reduced, and the entire lot eventually was well within the drawing limits. This was an important operation to bring under control, because the maintenance of an accurate length from the seat to the tip has a bearing on the later operation of grinding the tip. As long as the level varied with operators, numerous troubles arose in tip grinding. The control chart helped to obtain uniformity from several machines, showed the way for improving the technique of the operators, gave confidence to less experienced men, and increased the tool life. It also pointed the way to a methods improvement; namely, the substitution of an automatic hydraulic feed for hand feed.

The next operation, No. 6, the chamfering of the tip end, is performed on a

Fig. 5. Control chart for operation No. 5.



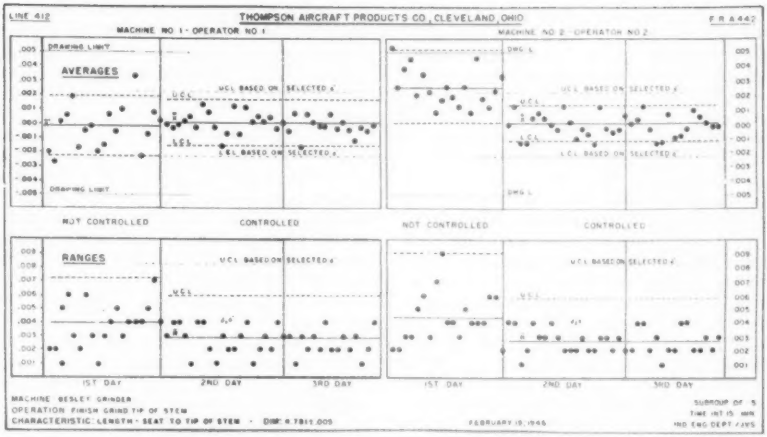


Fig. 6. Control chart for operation No. 8.

simple screw machine. The tolerances are inconsequential, and statistical control is not needed to keep the job running within the drawing limits. Operation No. 7, machining the undercut under the head, is performed on the same type of automatic single-spindle machine as is used in operation No. 3, and the same experiences and results were obtained by control chart procedures as on operation No. 3.

The grinding of the stem face is performed on a disc grinder equipped with an oscillating fixture. This requires a certain amount of skill because the man loads the valves by hand and the pressure against the grinding wheel is controlled by the "feel" of the operator. Control charts applying to this operation (Figure 6) show the comparison of conditions on two machines, each run by a different operator. Machine No. 1 with operator No. 1 applies to a fairly experienced operator; whereas machine No. 2, manned by operator No. 2, applies to a less experienced man. While the more experienced man held his average close to the drawing mean, and was also able to hold the pieces within a lesser spread than the operator on machine No. 2, neither one of the two cases was satisfactory. It is interesting to note that with the help of the control chart, not only was it possible to narrow down the range considerably, but also the averages could be held practically to the drawing mean. Closer limits than those called for by the drawing specifications are now held by the controlled process. This greater uniformity helps very much in the later operation of seat grinding, because it is not now necessary to separate the lots from various machines, nor is it necessary, in the later operation of seat grinding, to change the setups to suit such varying lots. This may be considered a typical example of how control chart procedures become a real help in straight-line production where there is interdependence of operations that have to be performed without changes in setups.

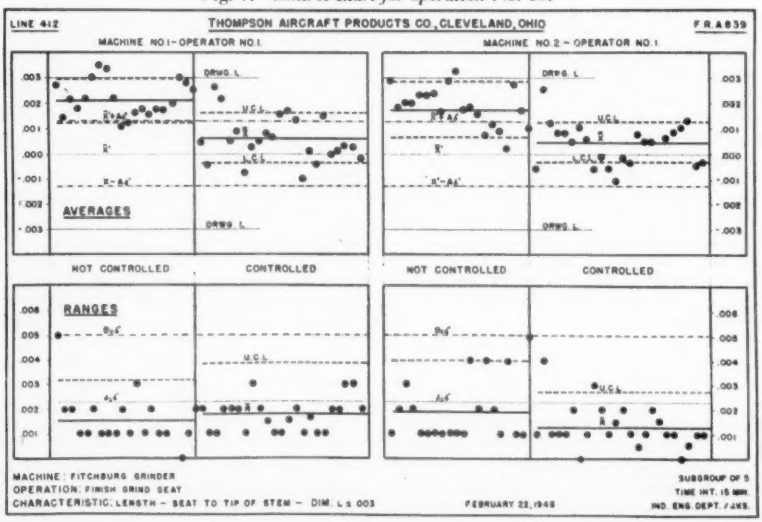
The grinding of the seat, operation No. 10, is a critical step in the manufacture of the valve. The seat forms the sealing surface of the valve, and therefore has to be properly finished, kept to accurate dimensions, run concentric with the stem diameter, and a gaging diameter on the seat has to be in close relation to the tip face of the stem. The manufacturing setup is a semi-automatic machine requiring only the loading and unloading of the valve; the rapid traverse, and the infeed of the grinding wheel, as well as the retraction of the grinding wheel slide and the dressing of the wheel, being performed automati-

cally. One operator runs two machines, and several pairs of these machines are on each line. The operators worked more or less in the dark and were rather uneasy about their jobs, because the scrapping of almost finished valves at this point is costly. The chart shown in Figure 7 for machines No. 1 and No. 2, run by the same operator, indicates that the man was not able to hold to the drawing mean and hesitated to make the proper adjustments. Without the control chart as a guide, the operator lacked the knowledge of where and how to adjust the machine in order to stay within the specified limits. With the process under control, no appreciable change occurred in the range, which is understandable because of the semi-automatic feature of this grinder, but the averages were brought and maintained very close to the drawing mean.

A quick study of the chart will reveal the savings obtained through the elimination of repairs and rejects. It should also be kept in mind that a uniform product was obtained from a number of machines used on this operation. Finally, it is worthwhile to note that the conditions illustrated on these charts were obtained after the tip grinding was brought under control. The valve is located in the grinder against the finished face of the tip, and the variations were greater than those shown on this chart before the tip grinding was brought under control.

The finish grinding of the stem, operation No. 11, is a conventional centerless grinding operation calling for comparatively close limits of ± .0005". Figure 8 shows that the operator was doing a fairly good job before the control chart procedure was put into effect, except that he was again running rather on the high side to avoid scrap. There is evidence of some assignable causes which are, no doubt, derived from the nature of the process, requiring, as it does, hand feeding and hand closing of the regulating wheel. Although the operator has time to check his work 100% on a "go" and "no-go" gage, the control chart helped considerably to bring the process closer to the drawing mean, and a steady improvement is noticeable. Incidentally, the use of control charts helped to eliminate the unnecessary dressing of the grinding wheels, and increased the length of the run between dressing operations by approximately 25%. This is an example of the helpfulness of the control

Fig. 7. Control chart for operation No. 10.



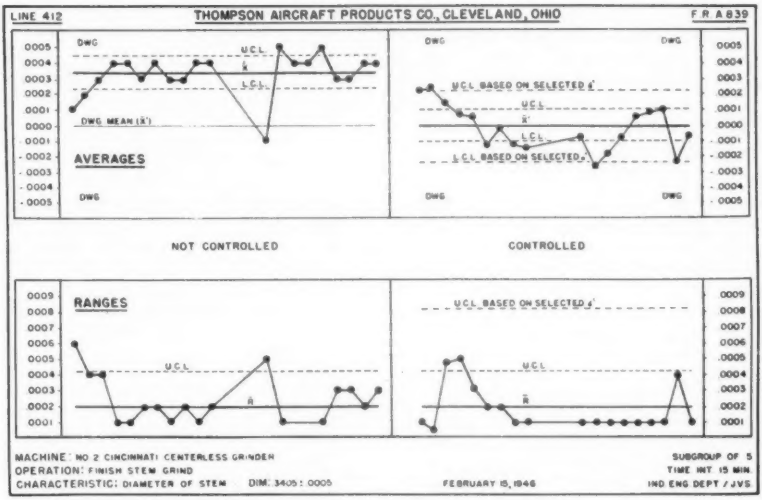


Fig. 8. Control chart for operation No. 11.

chart even though the machine operator has enough time between each cycle to check every piece coming off the machine.

The final inspection of the valves at the end of the line requires 100% visual inspection for finish. The dimensional characteristics may be checked by a sampling inspection procedure, as long as the entire process is controlled, so as to maintain a high quality level.

Conditions Prior to the Installation of Statistical Process Control

The experience with statistical control in the case discussed so far leads to certain general observations which will apply to almost any line production set-up. In general, the drawbacks and difficulties caused by a lack of statistical control will be as follows:

1. Operators with different techniques produce a non-uniform product which is a frequent cause of trouble in subsequent operations.
2. There is a tendency to play safe. The operator hesitates to work to the drawing mean and prefers the risk of producing parts which will require repairs, to the risk of making scrap. He makes his setup accordingly, and the results are loss of production, too many reworks, and too many machines put in the line.
3. The training of new help or inexperienced operators is unsystematic, because the reasons for variations cannot be clearly ascertained. Such conditions delay the attainment of the desired efficiency.
4. Too many inspectors are required. Inspectors are busy checking and rejecting work of poor quality instead of helping to produce work of satisfactory quality.
5. Production planning and scheduling break down, because the line output fluctuates when there is no process control.
6. The adequacy of adopted methods is not clearly demonstrated, and very desirable improvements, sometimes of a simple nature, are thus delayed.
7. The quality of the work in process is comparatively low, which necessitates a rigid final inspection with a consequent large amount of rejects.
8. Floor inspection is slow and cumbersome. The large amount of work under inspection and waiting for inspection increases the work in process

inventory. Floor space and equipment are poorly utilized. The installation of statistical quality control corrects these conditions and increases the flow of the product through the lines.

Rules for Statistical Control in Line Production

Uniformly applicable rules for statistical quality control in line production may be derived from the example dealt with in this article. They may be stated as follows:

1. It is necessary to have a good quality control organization which will co-ordinate its functions with the activities of other departments concerned with manufacturing, inspection, and industrial engineering.
2. When planning statistical quality control for line production, determine first the operations which lend themselves to statistical control, especially control chart procedures. Using comparatively short runs, make frequency distribution analyses, and draw charts of the conditions as they exist. Where several machines are used in the same operation, be sure to study all of them to determine the difficulties involved and their causes.
3. It has frequently been said and written that one of the first jobs of a quality control engineer is to sell statistical quality control to management. Our experience points in the opposite direction. The real task may well be to sell statistical control to the lower levels, that is, to supervision, and workmen. Management, as a rule, eagerly accepts progressive ideas. The quality control engineer must dispel the notion held by foremen and supervisors that control chart procedures will hold up or slow down production.
4. Remember that control charts will prove helpful, even where 100% inspection is feasible or necessary.
5. Pay particular attention to those cases where several machines are running on the same operation. Bring all in line and do away with the necessity of separating lots. Uniformity will thus be secured, which is one of the greatest assets of controlled straight-line production.
6. Not only the quality of the product, but also the life of the tools and grinding wheels is affected by the operators' technique. Control charts point out the better methods, and the knowledge thus gained can be used in the training of operators.
7. When similar products are made on the same line, but from different materials, statistical control is an excellent tool to bring out the differences in the characteristics of these materials, especially if they affect tool design and the materials used in the tools.
8. Where control limits exceed specification limits, do not discard the use of control charts or other statistical helps. In the first place, lots resulting from a controlled process are superior to the lots which were obtained from an uncontrolled process. Through intelligent use of the control chart method it may be possible to find means to vary the process or sequence of operations so that the controlled process eventually will fit drawing tolerances.
9. Finally, by all means, use the information available in statistical studies of a process to point out ways and means to improve the setup, tooling, or new methods leading to increased production.

Conclusion

The example of an automotive valve line will not conform in detail to every straight-line production setup, yet it represents a clear pattern of how quality control by statistical methods may be applied in general to line production of any type. The benefits accruing to management from this rather new tool of statistical control are well recognized. It is gratifying to know that the workmen are also pleased when they recognize how control chart procedures help them in their work, and that they take pride in their accomplishments. This contribution to employee morale and to the improvement of labor relations adds to the value of statistical quality control and should induce quality control engineers to make full use of it.

The Broaching of Brasses and Bronzes

Part II

by Harry H. Gotberg

Chief Engineer

Colonial Broach Company

Detroit, Mich.

Broaching Speed. In general, copper, brasses, and bronzes are broached at a cutting speed of 30 feet per minute. This is normally the economical top speed for modern hydraulic broaching machines. A high speed return on such machine helps keep the idle time between actual broaching cuts to a bare minimum.

Cutting Fluids. In broaching, lubricants perform the dual function of keeping the broach cool and reducing friction. They also assist chip flow, thereby increasing tool life. Both straight and soluble oils can be used when broaching brasses and bronzes, the former generally diluted with paraffin or kerosene. Water-soluble oils have the advantage of greater cooling action and thus are particularly good for light finishing cuts. Straight oils provide better lubrication for the heavier roughing cuts. Chlorinated or sulphurized oils are also used at times for special purposes.

Correct use of oils is as important as their selection. A generous flow at low pressure is usually desirable. Care should be taken to keep the oil free from chips, dust, and dirt. These impair finish and cause more rapid broach wear. In some cases, it will be found possible to broach brasses and bronzes dry. For specific recommendations on a given job, a broach manufacturer should be consulted.

Estimating Production. The production to be expected for any broaching operation may be calculated as in the following example:

Assuming:

Cutting Speed, fm	30′ (360″)
Return Speed, fm	60′ (720″)
Stroke, length	48 inches
Starting & Stopping	.2 sec.
Loading & Unloading	.5 sec.
Production Efficiency	85%

Then:

$$\text{Cutting Time} = \frac{48 \times 60 \text{ sec.}}{360} = 8 \text{ sec.}$$

$$\text{Return Time} = \frac{48 \times 60 \text{ sec.}}{720} = 4 \text{ sec.}$$

Starting & Stopping	= 2 sec.
Loading & Unloading	= 5 sec.
	19 sec.

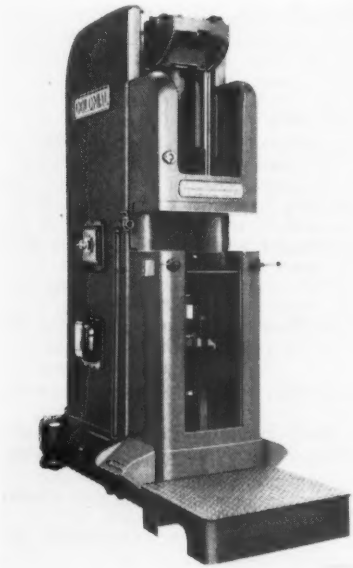
$$\frac{60 \text{ (min)} \times 60 \text{ (sec)} \times 85\%}{19} = 160 \text{ per hr.}$$

Fig. 9. The horizontal machines are considered the "all around" machines in the broaching field. They are primarily used for broaching round holes, keyways and splines.

Handling of Broaches

In addition to correctly designing a broach for a specific application, success in broach use involves a number of factors completely independent of broach design and selection. Often one or another of these factors is overlooked with the result that broach life is shortened, production is lower than anticipated, and finish, dimensions, and accuracy are impaired. These also include not only correct handling and storing of broaches in the shop, but proper means of interdepartmental transportation between the sharpening equipment and the broaching machine.

Fig. 10. The Pull-up broaching machine is used primarily for internal broaching such as rounds, splines, squares, gear teeth, etc.



In shipping, broaches should always be packed so that their teeth come into contact only with wood or some other soft substance. They should also be properly supported against breakage due to such shock as may occur if the shipping box is accidentally dropped. In the shop, the teeth of a broach should never be allowed to come into abrupt contact with any hard material such as a metal bench, edges or sides of a storage bin, or against another broach. Remember that the teeth of any broach are exceedingly hard and sharp. Many a shop man has learned this the hard way by inadvertently rubbing his finger or hand against them! Even the slightest nicking of a tooth reduces the efficiency of the unit. It may require resharpening or reconditioning to again place it in proper operation.

Broach Racks. The most satisfactory method of handling broaches in the shop is to provide racks designed to support each individual broach in a nearly vertical position. Contact of the broaches with the rack should be near the ends of each broach regardless of its length. The contacting surfaces of the rack should be of wood or some similar soft material. Avoid having the cutting teeth of the broach strike any hard material while the broaches are being placed in or removed from the rack. Storage bins should also be lined with wood.

When broaches must be transported to and from the shop and the tool room, the rack may be equipped with wheels or rollers so that it may be easily moved and brought close to the broaching machine.

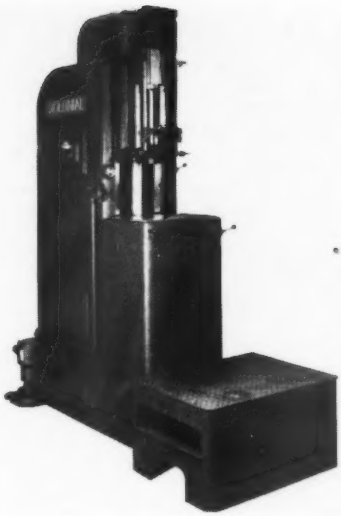


Fig. 11. The Pull-down machine is similar to the Pull-up machine except that the action is reversed. It is used for the same type of work, but can be used more conveniently than the Pull-up where it is necessary to produce an internal profile accurately related to an outside surface.

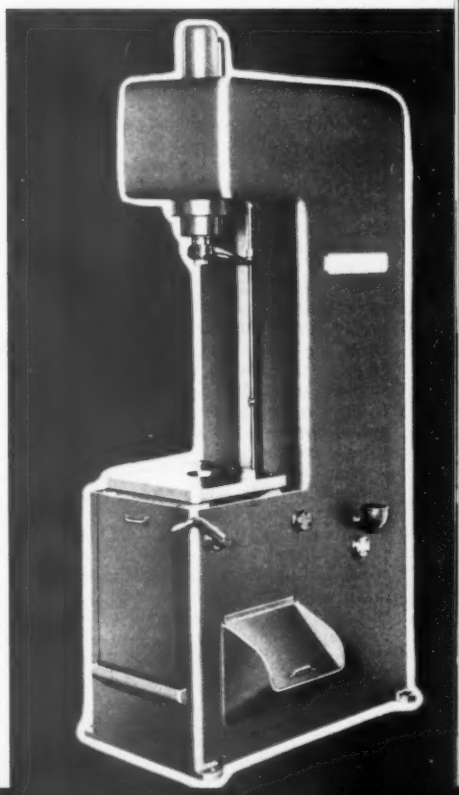
Broaching Machines

Types of Broaching Machines. Broaching machines are generally divided into two classes, the Horizontal and the Vertical types. The horizontal types, Figure 9, are considered the "all around" machines in the broaching field. They are used not only for broaching round holes, keyways, and splines, but are also extensively applied to surface broaching operations when equipped with the proper fixtures and tooling. For accurate helical spline broaching, horizontal machines can be fitted with helical drive heads and master lead bars which rotate the broach as it is being pulled through the piece. Thus, the correct helix angle is always assured. Accuracy of the broaching operation is further increased by use of guide bars or follow rests which support the outer end of the broach as it passes through the piece.

Vertical broaching machines are classifiable into four types: the Pull-up, the Pull-down, the Vertical Press, and the Ram Type Surface Broaching Machine. The Pull-up broaching machine, Figure 10, is used primarily for internal broaching such as rounds, splines, squares, gear teeth, etc. It is equipped with an automatic broach handling mechanism, making it unnecessary for the operator to handle the broach. Pull-up machines are used more frequently where it is not important to accurately locate the internal contour in relation to any outside contour such as gear teeth, etc. The part is merely dropped over the end of the broach shank, the operator presses a lever, and the broach handling mechanism and the machine ram do the rest.

The Pull-down machine, Figure 11, is similar to the Pull-up except that the

Fig. 12. Vertical presses are often used for hole broaching when fitted with push-broaches. They may also be used for surface broaching when equipped with a fixture having a tower for supporting and guiding a broach bar.



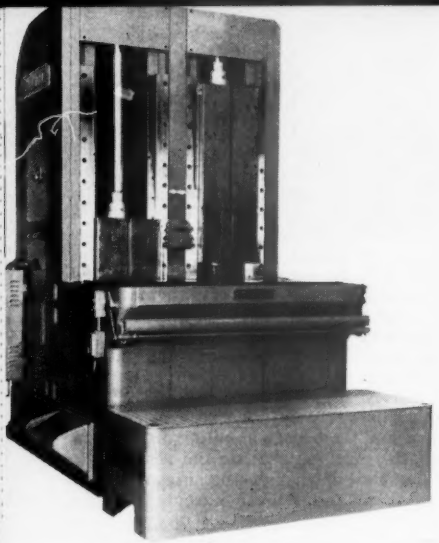


Fig. 13. Ram type machines are used most widely for surface broaching, particularly the broaching of outside surfaces by means of "slabbing inserts". These inserts are mounted on a slide type ram, vertically guided by gibs held rigidly on the machine's column, such as this Colonial Dual Ram.

action is reversed. It is used for the same class of work as the Pull-up but can be used more conveniently than the Pull-up where it is necessary to locate an internal contour (such as splines) in relation to some outside contour (such as gear teeth). In such a case, the part is loaded on top of the platen, using a locating type fixture for holding. The puller is designed with a locating tang to hold the broach in correct relationship to the part. The Pull-down is also preferable for broaching large and massive parts since the work can be positioned on top of the platen, thus giving it a firm support and also preventing the parts from dropping after the broach has been pulled through the hole. Pull-down machines are also equipped with automatic broach handling mechanisms.

Vertical hydraulic presses, Figure 12, are often used for hole broaching with push-broaches. A semi-automatic device can be added which prevents the broach from falling down into the base of the machine. After the broach is pushed through, the part is removed and the broach returned with the up-stroke of the ram. Pull-up broaching attachments are also available for such presses. Vertical presses may also be used for surface broaching when equipped with a fixture having a tower for supporting and guiding a broach bar.

Ram type machines, Figure 13, are most widely used for surface broaching, particularly the broaching of outside surfaces by means of what are termed "slabbing inserts." These inserts are mounted on a slide type ram, vertically guided by means of gibs held rigidly on the column of the machine.

Machine Setup

Adequate Machine Capacity. To assure proper machine setup, the first point is to make sure that the broaching machine is of adequate capacity for the job

(CONTINUED ON PAGE 100)

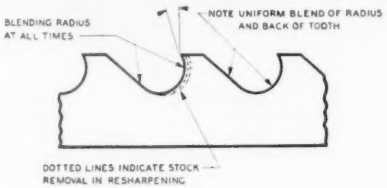

BLENDING RADIUS AT ALL TIMES
NOTE UNIFORM BLEND OF RADIUS AND BACK OF TOOTH
DOTTED LINES INDICATE STOCK REMOVAL IN RESHARPENING

Fig. 14. Proper method of sharpening broach teeth. Note that correct form and contour of teeth are accurately maintained. Original tooth form permits chip to curl and clear itself from edge of tooth. This also shows effect of successive sharpenings.

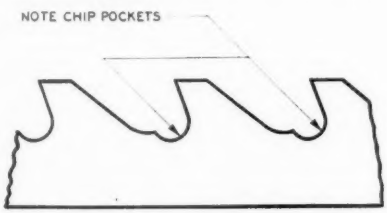


Fig. 15. Here, original tooth contour has not been maintained. Cutting wheel edge has produced a groove below proper curvature of tooth form, creating a pocket which will cause chips to "load up", thus decreasing chip clearance. This may result in broach breakage. A smooth finish on broach teeth also helps produce a greater number of parts between sharpenings, since there is less tendency for the cutting edges of the teeth to break down than when the edges are rough.

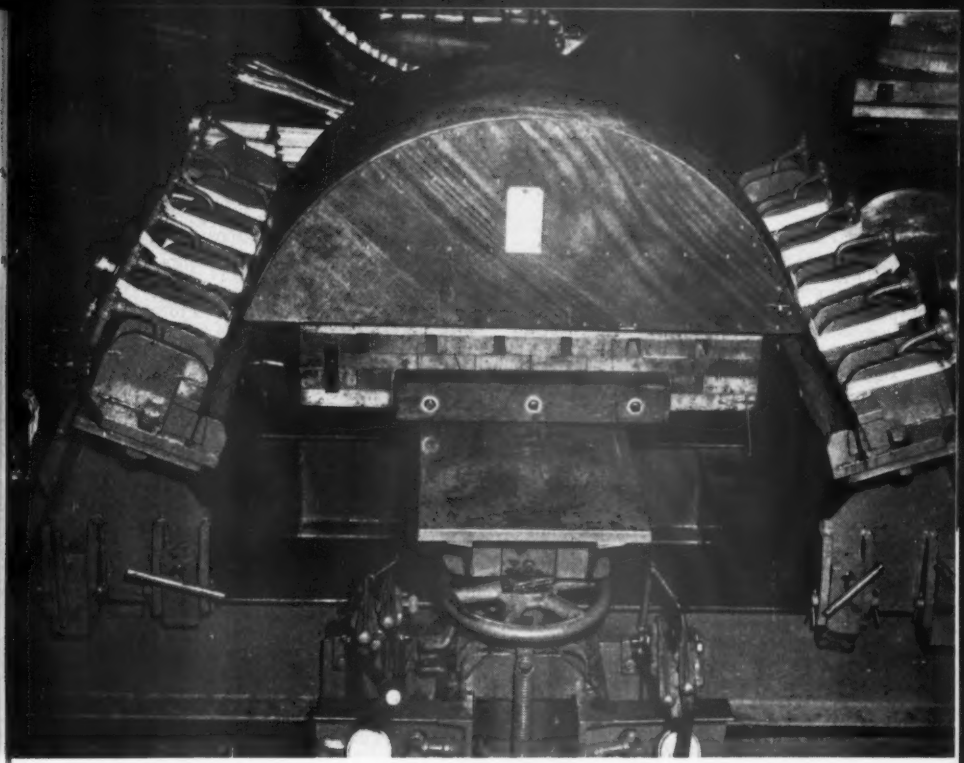


Fig. 1. Conservation of weight and material is effected in this cowling die by a wood core covered with a two- to three-inch layer of casting resin. This stretchpress setup produced aircraft cowlings to close tolerances.

Press Tool Applications Of Casting Resins

Under the impetus of war, the use of various synthetic casting resins for the fabrication of stretchpress and hydropress dies as well as for drill jigs, assembly jigs, holding fixtures, and other production aids has gained wide acceptance. Cast plastic dies are especially well-suited for forming the light metals used in aircraft production. As a result, much of the early experimental work on possible applications of casting resin was carried out in aircraft plants.

The success of this experimental work was a contributing factor to the phenomenal production schedules which the aircraft industry was able to maintain. It was possible to produce cast tools in a small fraction of the time required by more conventional methods. The low cost of the plastic dies when compared with metal dies was of little importance during wartime but provides a second

	Baked 8 Hours at 140° F 5% Accelerator	Baked 8 Hours at 140° F 8% Accelerator
Shrinkage from Mold Dimension (inches per inch)	0.0025"	0.0025"
Hardness, Rockwell "R" Scale	115	115
Flexural Strength, psi	8,000	12,000
Modulus of Elasticity in Flexure	5 to 7 x 10^{-5}	5 to 7 x 10^{-5}
Impact Strength, Izod—ASTM (ft lbs per inch of notch)	0.24	0.24
Compressive Strength, psi ASTM	13,000	12,000
Tensile Strength	5,000	5,000
Linear Coefficient of Thermal Expansion (inches per inch per ° F)	0.00005	0.00005
Specific Gravity	1.30	1.30

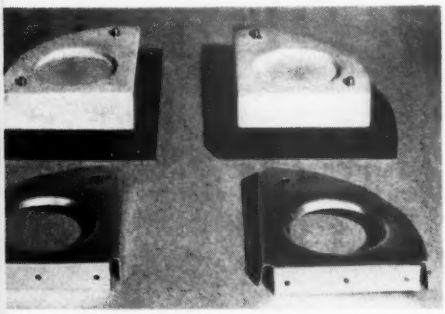
powerful argument for peacetime applications.

Typical of the synthetic resins used for this work is Durez 7421-A casting resin supplied by Durez Plastics & Chemicals, Inc. This is a phenolic thermosetting resin in liquid form which can be cast in simple molds without the use of pressure. Cast pieces require only a mild bake (8 hours at 140° F for average size castings) to develop their full strength. The resin is used with an accelerator which makes it more reactive so that it will harden in less time at a lower temperature. The percentage of accelerator used has an effect on the physical and electrical properties of the finished casting. Negligible dimensional changes occur upon immersion or humidification of the casting.

The accompanying table shows typical properties of this cast resin which are of interest to tooling and production engineers.

Patterns for the mold used for casting the resin may be made of wood, plastic, plaster, metal, Masonite or other composition board. Often an actual part may be used directly as a pattern. The molds are made from casting plaster, wood, metal, rubber, or latex. The molds may also be made from the casting resin itself using the same techniques as are employed in producing the final castings. The shrinkage factor should be allowed for in the original pattern or in the mold

Fig. 2. These duplicate hydropress dies, mounted on Masonite, have been used under 75 tons press load. Although in test cases these dies have withstood 270 tons press load, in general, cast resin tools should be used at lower pressures and only with light metals.



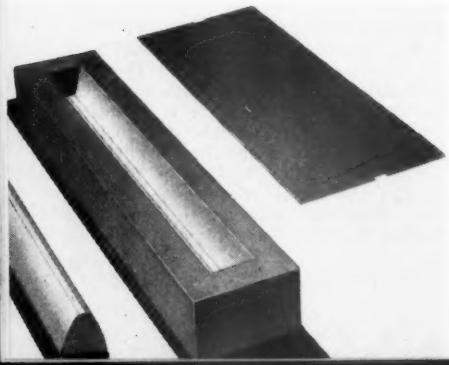


Fig. 3. A cast resin punch and die for forming 24-gauge aluminum reflectors. The fine surface texture of the Durez resin and its low coefficient of friction contributed to the efficiency of the reflecting surface.

when it is desirable to keep a finished piece within close tolerances.

When the mold is completed, the inside is coated with various primers and parting agents according to the nature of the material that has been used for the mold and the degree of surface finish that is desired on the finished castings.

When the mold is ready for use, the resin and accelerator are mixed, and the filler, if any, is added. Various fillers may be used but are not recommended as they usually lower the strength of the finished casting. After the mix has stood for a short period to allow air bubbles to escape, it is poured slowly into the mold and allowed to stand for at least four hours. The mold and its contents are then placed in an oven for the necessary baking period.

Upon removal from the mold, the casting is ready for use unless some provision for mounting is necessary. Mounting usually entails the routing and grinding of the base, the drilling and tapping of suitable mounting holes, and fastening by means of coarse thread machine screws to a Masonite, plywood, or other type of base. Incidentally, the casting resin may be machined in much the same manner as brass. Sanding is accomplished with regular wood sanding equipment, and for polishing, pumice and other standard polishing compounds are used. If the mold has been carefully prepared, the cast resin will have a satisfactory surface and will require little or no further finishing.

In the construction of large cast resin dies, it is possible to lessen considerably the volume of resin used by coring them with wood, thus making the wooden core part of the die itself. The cast resin layer or cross-section must be thick enough, however, to withstand any stresses set up by the shrinking of the resin around the wood. Cast resins have excellent adhesive properties when used in conjunction with wood, hence its choice as a core material. Metal inserts may also be molded into the plastic providing they are protected with a suitable coating to prevent the acid accelerator from attacking the metal.

Typical examples of dies produced from Durez casting resins are shown in the accompanying illustrations.

The cowling die mounted on the stretchpress, Fig. 1, is approximately four feet wide and two feet thick and has a wood core. The core weighs 350 pounds, and the two- to three-inch layer of resin covering it weighs 250 pounds. The whole unit was produced in twenty-four hours; two full days faster than a similar die of conventional material could be made, and at a cost of less than fifty percent. The cowlings produced on this die were well within close tolerances.

The duplicate hydropress dies, Figure 2, mounted on Masonite, doubled production at low cost. These dies which have been used under 75 tons press load have been found in some tested instances to be capable of withstanding 270 tons press load, equivalent to about 12,000 psi. Normally this resin should be used at lower pressures and, in general, only with light metals.

Another interesting and unusual application of the Durez casting resin is the reflector die, Figure 3, in which both the male and female sections are cast from the resin. These dies were used for forming 24-gauge aluminum reflectors. Of particular note is the fact that the dies were used on a power brake, Figure 4, in a plant where no hydraulic presses were available. A checkup of the dies after forming 2000 pieces revealed no signs of wear. It was reported that the surfaces of the formed aluminum reflectors had a more consistent smoothness than similar reflectors. It is believed that this is due to the surface texture of the Durez resin and its lower coefficient of friction. Similar reports have been received relative to both hydropress and stretchpress dies.

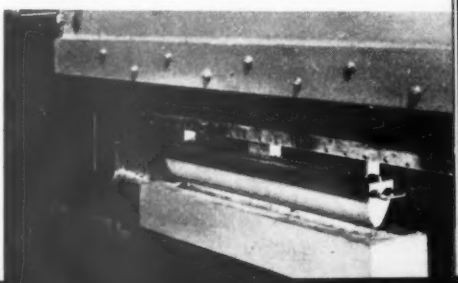
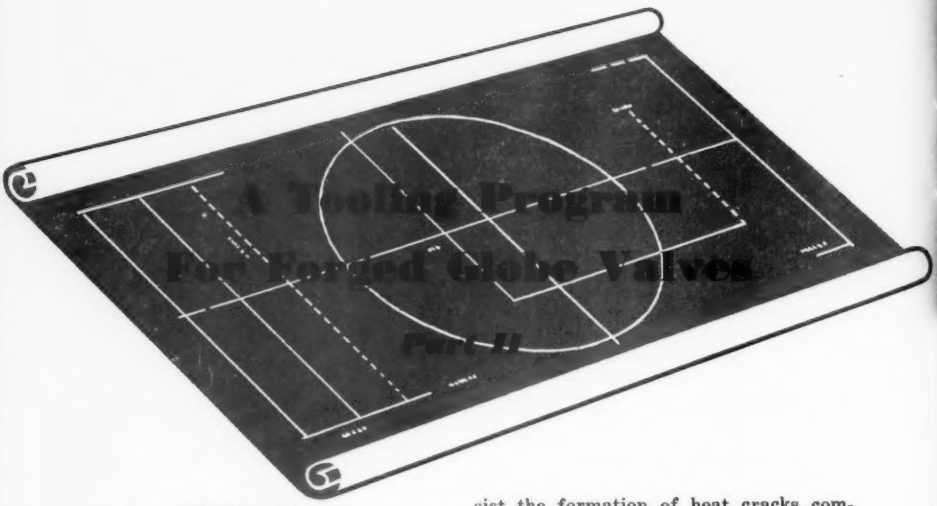


Fig. 4. The tooling of Figure 3 as used on a press brake. After the forming of 2000 pieces the dies evidenced no signs of wear. The job constituted a successful and low-cost method of forming the reflector.



A Tooling Program For Forged Globe Valves

Part II

Forging Dies

The temperature to which different materials must be heated for successful forging varies with their physical properties and chemical analyses. Steel should be forged at 1600° F to 2400° F, aluminum at 900° F, and brass at 1500° F. In selecting the tool steel from which to make forging dies, the forging temperature at which the material works best has to be taken into consideration because all die steels will not withstand the higher temperatures to which the forging blank must be heated. When forging brass at 1500° F the heat flow which occurs causes the die to become very hot resulting in damage to the die by cracking if the steel used is not of the type capable of withstanding the elevated temperature.

To offset this condition, the Parker Appliance Company has adopted the die insert construction method in building their dies for brass globe valve body forgings. This type of die is composed of two parts, the die block and the die proper in the form of an insert, as illustrated in Figures 7 and 8.

Latrobe's LPD hot forming tool steel is currently used by the Parker toolmakers in making the die inserts. This is a low carbon, high tungsten, chrome, vanadium tool steel. It will maintain the desired physical properties up to and including a dull red heat, and will resist the formation of heat cracks common to lower alloyed steels when used at elevated temperatures.

The Parker engineers have found it to be more economical to follow the die insert method of construction, because the insert proper requires a considerably smaller quantity of expensive die steel than would the die block if it were made entirely from tool steel. When the die is worn out and needs to be replaced, only the insert has to be made, which again saves on the amount of die steel used for replacement. Since the die block does not have to withstand as high a temperature as the insert, a lower alloy steel such as Heppenstall's Hard-Tem is specified.

by Carl F. Benner
Assistant Editor

The valve body cavity of the die insert is milled out on a Gorton 9-J Duplicator, Figure 9, using the master die block as the control pattern for the Duplicator tracing stylus. Here again, the keyways

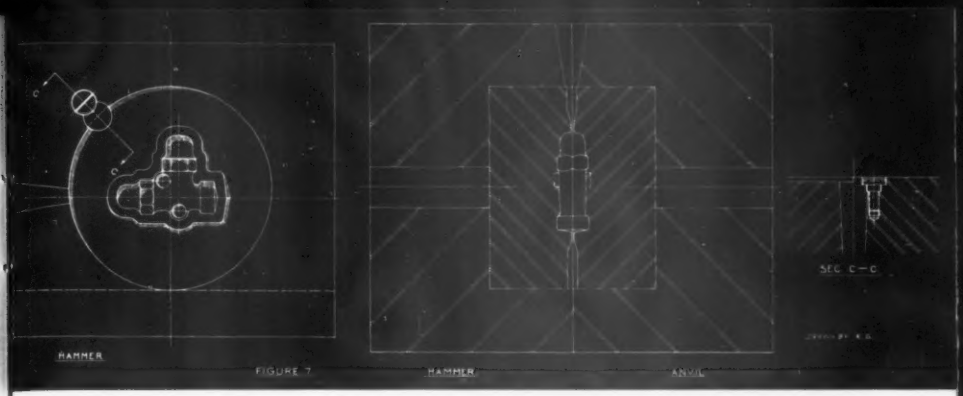


Fig. 7. The die insert method of construction. Detail C-C shows the means of locking the die insert into the die block proper.

of the master die block are used for holding and accurately positioning it in a fixture on the table of the Duplicator. This method of positioning assures accurate alignment of the centerlines of the forging die in relation to the master die block. In this operation the master die block is clamped to the table under the tracer spindle on the right, Figure 9, and the die insert block is clamped to the table under the milling spindle on the left.

A drawing of the die insert construction is shown in Figure 7, and although it is of an angle valve body instead of the offset valve body under discussion, the principle of construction and the method of anchoring the insert in the die block are the same.

A tapered hole, with its center located on the line separating the insert and the die block, is drilled, and into this is fitted a #10 x 4″ taper pin. Another hole is drilled 9/16″ from the center of the tapered hole, step counterbored, and tapped to take a #2 ASA lock screw, Section C-C, Figure 7. The counterboring is performed with the taper pin in place thereby providing a seat in the top of the taper pin with which the head of the lock screw engages. This type of construction assures positive locking of the insert in the die block.

Figure 8 illustrates the hammer and anvil members of the die for the forged offset valve body. The forged blanks must completely fill the die cavities; therefore to allow the material to flow freely in all directions a large flash is provided, ranging from 15 to 20 percent of the forged blank volume. The flash line thickness is held to 1/16″ on both hammer and anvil die, thus making the total thickness of flash ⅛″ at the flash line. The flash line width, between forg-

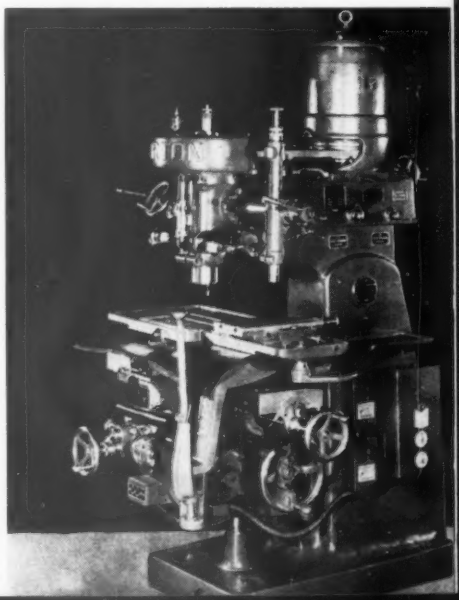


Fig. 9. A Gorton Duplicator, Model 9-J, is used in the Parker Appliance Company toolroom for milling out their forging die cavities. A special fixture for holding the master die block is positioned on the compound slide at the right-hand end of the duplicator table and under the tracing stylus quill. The die insert block is placed under the cutter spindle. Proper centerline orientation of the work and master is assured by the fixed relationship that is established, throughout the entire tooling program, between all operations and the Goss & DeLeeuw chuck and fixture keyway centerlines.

A Tooling Program For Forged Globe Valves

Part II

by Carl F. Benner
Assistant Editor

Forging Dies

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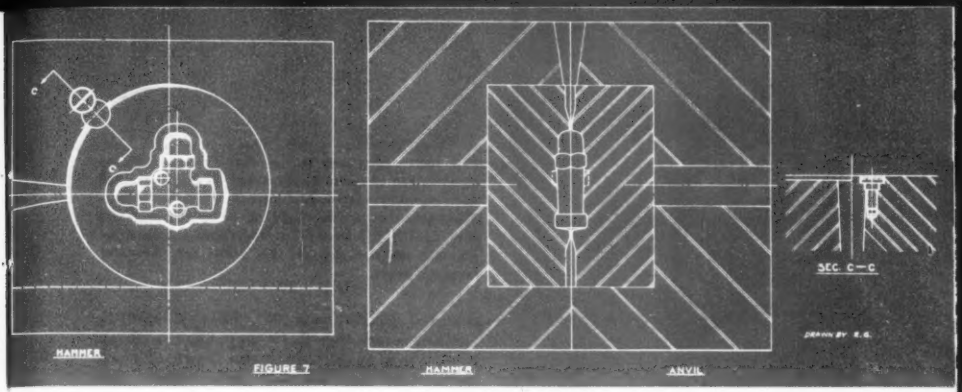

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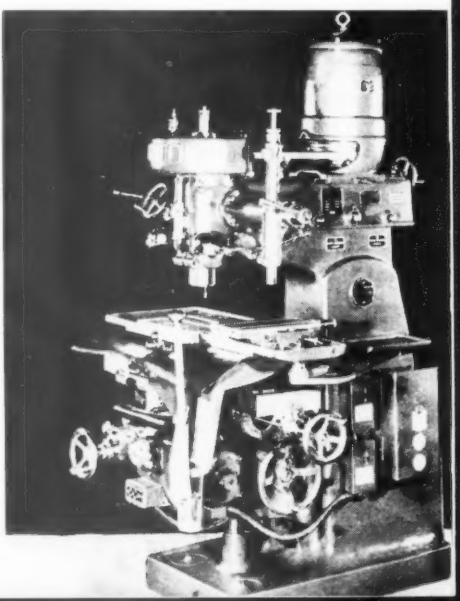

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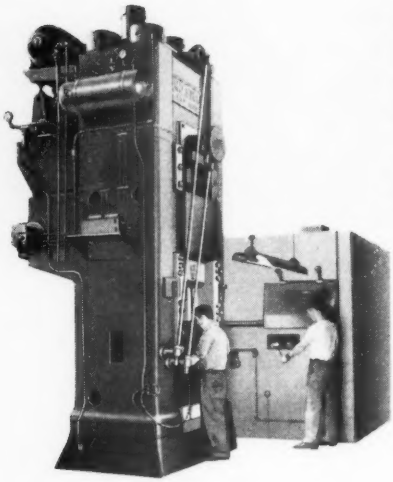


Fig. 10. The portion of the Parker forging department devoted to turning out heavier work such as forged brass and aluminum valve bodies. The operator at the right is removing a brass slug (1500° F) from the Morrison furnace for placing on the die in the 1000 ton Minster forging press.

ing and gutter, is 3/16". The maximum thickness of the flash beyond the flash line is held to ¼" since the depth of each gutter in the hammer and anvil dies is ⅛".

After all machining and hand finishing operations on the die have been completed, the anvil and hammer dies are clamped together and through opening D, Figure 8, molten lead is poured into the cavity. In this manner a sample is taken for checking the cavity dimensions of the die which has to produce forgings within .005" tolerance of specifications.

Fig. 8. Cross-sectional details of the hammer and anvil dies for forging the Parker Offset Globe Valve body. Dotted outline in lower left-hand view shows relative size and positioning of cold-drawn brass slug or billet. The final checking of the dimensions and fits of the mating die cavities is done by pouring lead into opening D, thus obtaining a lead model of the forging.

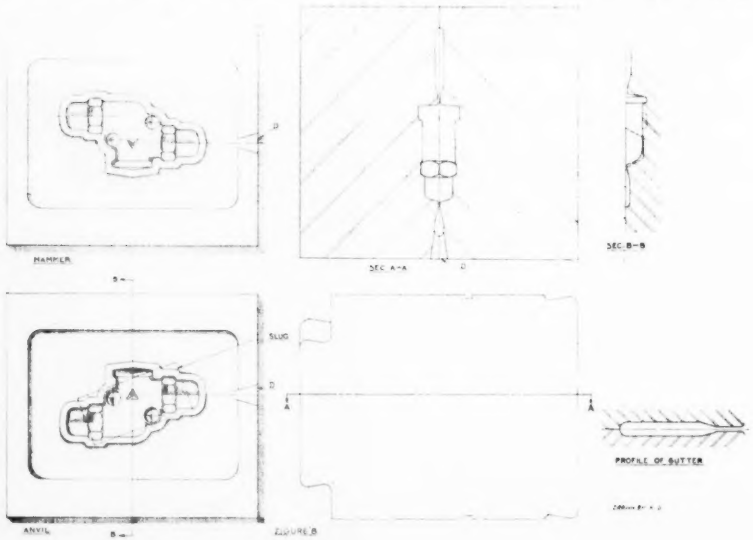


Fig. 11. A heated slug positioned over the anvil die. One stroke of the press ram and hammer (upper) die will form the valve body shown in Figure 12. All Parker brass and aluminum valve body forgings are completed with one blow of the hammer die.

The Forging Operation

The forged blanks are produced in the Parker shop on a 1000 ton Minster Knuckle Joint Forging Press, Figure 10. The ram on this type of press can be adjusted for a predetermined length of stroke to give the necessary space (within the limits of the press) between the hammer and anvil dies. This adjustment feature makes it possible to hold the thickness of the flash line next to the forged body to that specified, i.e., 1/8". This feature, at the same time, protects the dies from damage because the surface of the hammer die is not permitted to strike the surface of the anvil die with appreciable force.

Figures 11 and 12 show the hammer and anvil dies set up in the Minster press. In Figure 11 the heated slug or billet is in position for the forging stroke, and in Figure 12 the forging stroke has been completed and the forged blank is ready to be removed from the die. The parts pictured here being forged are not those of the particular offset valve body under discussion, but the forging procedures are the same for all types of Parker valve bodies.

Initially, when putting a new model forging into production, the length to diameter ratio of the forging slug or billet is determined by trial and error. The variable factors are that with the slug positioned either vertically or horizontally over the die cavity a combination of diameter and length can be found that will result in the most uniform flow of material into and throughout the die cavity with, at the same time, just the right creep and cooling of flash to insure the highest quality, metallurgically, of forged body. When the optimum combination or approximate dimensions are then found, the exact length for the slug is determined by computing the volume of the forged blank and then adding 15 to 20 percent to take care of the volume of flash material. The slugs are then cut uniformly to this calculated length on an automatic cutoff machine from cold-rolled brass bar stock.

The slugs are heated to 1500° F in a Lindberg or Morrison furnace. The operator at the right in Figure 9 is removing a slug from the furnace preparatory to placing it on the die. As soon as the slug is positioned on the die (see dotted outline of slug in lower left-hand

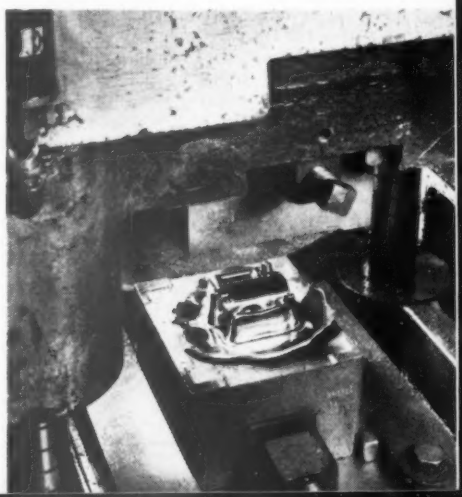


Fig. 12. The forged valve body with excess flash material. Note that the flow of the flash is governed by the flash line and gutter pattern plainly seen in Figure 11. Where the greatest amount of metal is to be displaced adequate gutter capacity has to be provided in order to expedite the flow of metal.

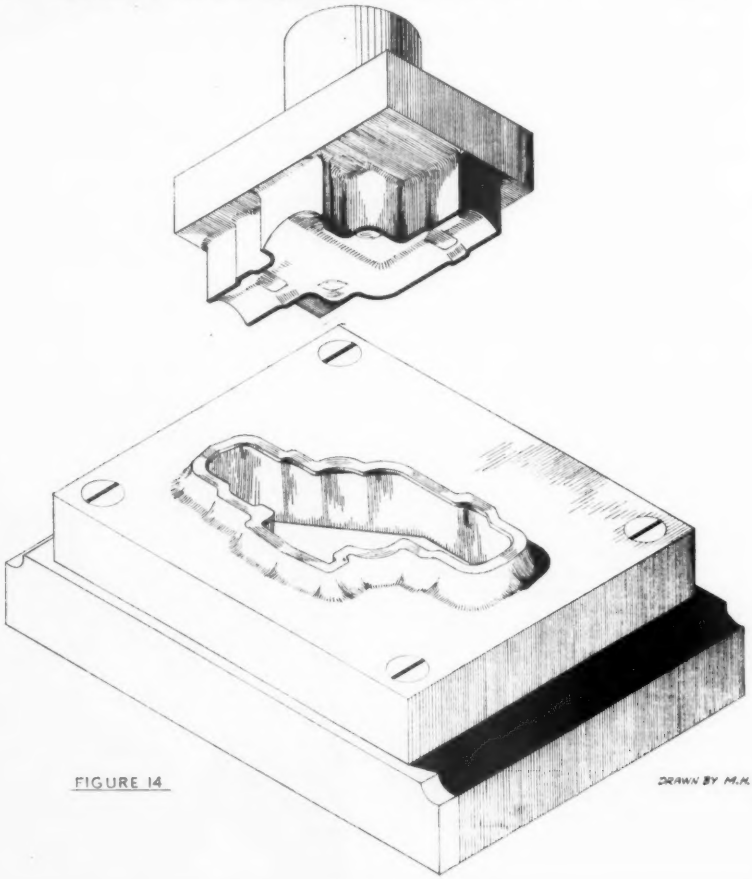
view of Figure 8), the press operator starts the down stroke of the ram, to which the hammer die is attached, by stepping on a foot pedal and by one stroke of the ram the round slug is converted into a forged valve body blank.

To prevent the forging from sticking in the die, a parting fluid, compounded of graphite and oil, is sprayed on both dies by a double nozzle oil gun. This spray equipment, Figure 9, consists of a tank, mounted on the side of the press near the top, with a line running down the side of the press to a shutoff valve. From this valve, a flexible line with the double nozzle gun on the end is available for the operator to use. He operates the spray by pressing a trigger which actuates a nozzle valve in the gun.

Trimming Die

As the forged blank comes from the forging press the flash or excess material that flowed into the die gutters is still attached and must be removed. This is

Fig. 14. A perspective view of the trimming punch and die. The hardened cutting edge of the die has a land of 1/16" and the balance of the opening is relieved 3° on a side which permits the body forging to drop on through as flash material is severed.



accomplished by a set of trimming dies mounted in a punch press.

The trimming dies are composed of two parts, the punch and the die shoe, Figures 13 and 14. The face of the punch and the contour of the die shoe opening are milled out on the Gorton Duplicator, Figure 9, using the master die block as the control pattern. Here again, the keyways on the master die block serve to position the master block on the duplicator table, thus assuring the shape of the trimming punch and die shoe will be an exact duplication of the master die block. The material used for the die shoe is Wheelock, Lovejoy & Company's Hy-Ten, "M" Temper, Oil-hardening steel. The trimming punch is made from TS #6 and is not hardened.

It should be noted that the face or cavity of the punch is an exact mating duplicate of the shape of one half of the forged blank except that it does not extend quite half way around the body. This shortening of the punch cavity allows for the thickness of flash material around the forged blank, and insures that when the trimming punch strikes the forging for the trimming operation the impact from the punch is distributed uniformly over that total area of the forging which might occur in the trimming operation should the pressure not be evenly distributed.

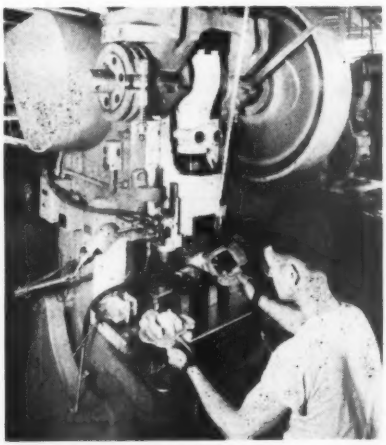
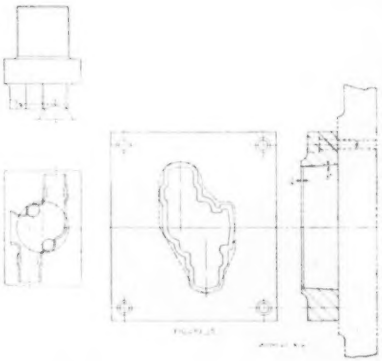


Fig. 13. The trimming die shoe and trimming punch. The punch cavity is profiled (in conformance to the upper master die block) to fit over the forged body. The cutting edge or opening in the die is profiled to the shape of the valve body.



The trimming operation is performed on the Minster #5, 45 ton Open Back Inclinable Press shown in Figure 15. The forged blank is placed within the profiled opening in the die shoe and is supported by its surrounding flash material. The trimming punch comes down to close-fitting engagement with the upper area of the forging; the balance of the downstroke travel forces the forging through the die opening thus shearing the excess material. As shown in Figure 13 the sharpened edge of the hardened die opening has a 1/16" land and is then relieved 3°. This insures clean removal of the flash from the valve body and the holding of specified size throughout the production run.

(To be Continued)

Fig. 15. A flash trimming operation being run on the forging shown in Figure 12. This setup in the Parker plant is made on a Minster #5, 45 ton press. The 1/16" land around the cutting edge of the die assures a long tool life due to providing sufficient material for several regrinds as the edge may become dull. Good housekeeping and safety precautions prevail throughout the Parker shops. Note the "life lines" whereby with each downstroke of the press the operator's hands are withdrawn from the danger zone.

Exact Size Of Trial Cuts Is Measured

A simple, effective solution to the problem of measuring the exact size of trial cuts in bringing a hole up to size during boring or grinding, has been provided by using the Moore Direct-Reading Leaf Taper Gages. Conveniently packed

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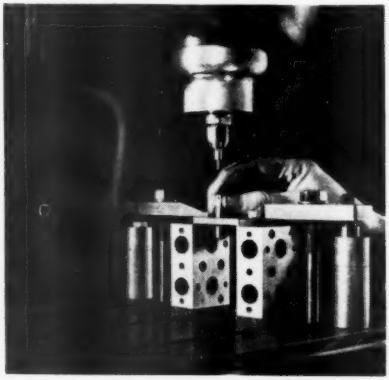

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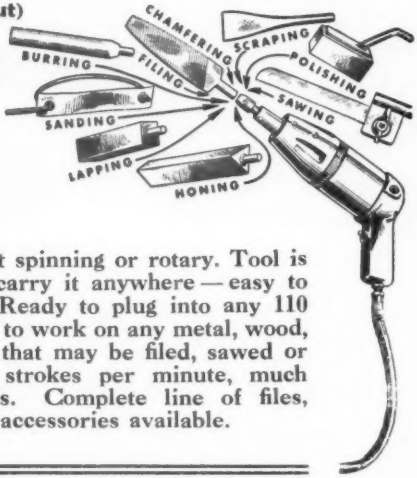

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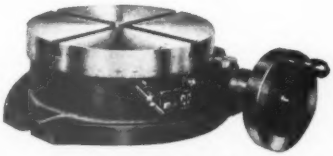

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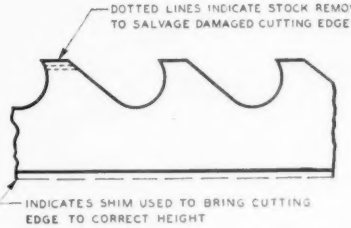
Fig. 16. Relative to surface broaches designed for use with a broach holder, or where adjustment or "shimming" to increase broach height is allowed, teeth can be reconditioned by re-stepping and re-backing off the top of the tooth form. Proper stepping, backing off, and tooth depth must be maintained. In most cases, broach should be sent to manufacturer for such work, since the same machines employed for producing broaches should be utilized to restore the broach to its initial condition.


DOTTED LINES INDICATE STOCK REMOVAL TO SALVAGE DAMAGED CUTTING EDGE
INDICATES SHIM USED TO BRING CUTTING EDGE TO CORRECT HEIGHT

(CONTINUED FROM PAGE 88)

in hand. This, of course, includes length of stroke. The capacity must always be sufficient to avoid both stalling the broach in the work and jerky operation during the cutting stroke. Shop maintenance of broaching machines should be such that the machines are kept up to their rated capacity at all times.

Alignment of Machine. The centerline of the ram head and puller must be in alignment with that of the work. Similarly the follow rest, if used, should be in alignment with the centerline of the broach. Wear in the ways of the machine, in the puller mounting, in the follow rest bars, or in the broach mounting hole in the follow rest, should not be excessive if accuracy is to be maintained and the danger of broach breakage avoided. This applies to Pull-up, Pull-down, and Horizontal type broaching machines performing any kind of hole broaching, such as round, spline, or keyway cutting operations in copper, brass, and bronze.

In helical spline cutting operations where a broach drive head is required, the master lead bar, driving mechanism, and puller adapter must be maintained in good condition if an accurate helix angle of the broached splines is to be obtained. This is doubly important if the spline in the part to be broached is of considerable length and the helix angle is large (short lead).

Fixtures

Round, Spline, and Keyway Broaching. When broaching holes, splines or keyways, the centerline of the fixture in the face-plate or platen of the machine must be as accurately located as possible. The fixture should fit and hold the work as closely as possible and still permit ready insertion and removal of the part. Where a question of extreme concentricity is involved, it is usually better from a production standpoint to broach *first* and then locate and machine the OD *in relation to the hole.*

Surface Broaching. For surface broaching, the fixture must be of rigid construction to prevent any movement of the part during the pass. The method of holding the part in the fixture and the pressure applied in holding it in place must be sufficient to prevent slippage during broaching, as well as to hold the part in correct relationship to the broach cutting surfaces when inserted. This is

Fig. 17. Special gages are available for checking tooth form for correctness after grinding.

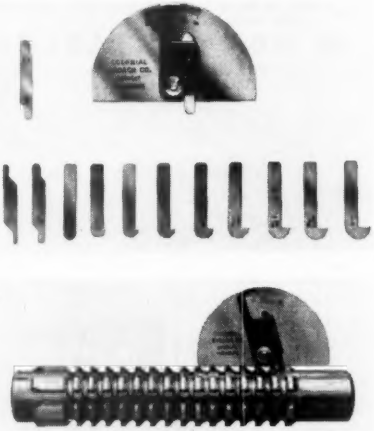
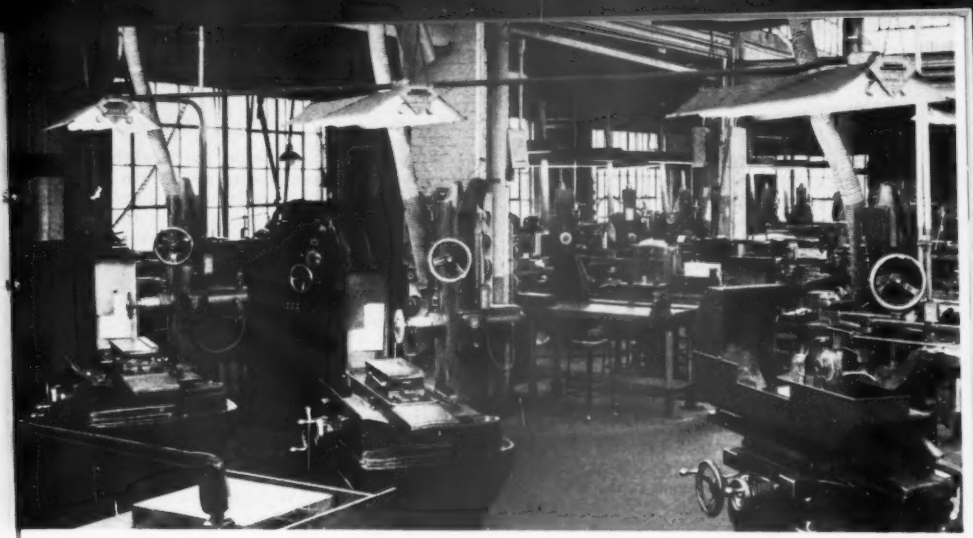


Fig. 17-A. Method of using gage for checking tooth form.



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important both to assure accuracy and prevent catching of the part against the broach during the pass. Just as many difficulties have been traceable to insufficient fixture rigidity in broaching as in other machining operations. Be sure the part is well supported.

Indexing Fixtures. The precautions concerning rigid construction of fixtures and holding the part rigidly apply especially to fixtures which also handle the indexing of parts between successive broach passes. The design of the indexing fixture must be such that there is no backlash which would permit movement of the part during the pass of the broach. This applies particularly to continuous high production surface broaching operations where extreme accuracy is required as in producing aircraft and similar precision parts.

Broaching Cored Holes. Whenever a cored or forged hole is to be broached from the rough, an "equalizing fixture should be used. The use of a fixture of this type prevents highly localized or unequally distributed tooth loads which tend to force the broach out of alignment. For the same reason, a drilled hole should be square with that face or surface of the part which locates against the broaching fixture.

Machine Operation

A broach should never be returned to its starting position until the work has been removed. Unless the piece is removed the end of the broach may strike the edge of the hole, causing possible broach breakage and it may also damage the fixture.

Before starting the broach pass, the piece should be firmly seated in the fixture. In round or spline broaching, this means that the piece must be as fully seated in the retaining adapter as possible, and that it is seated "all the way around" and is not "cocked." In surface broaching, the piece must be properly seated and the retaining clamps brought up to full contact pressure, either by hydraulic or mechanical action, depending on type of fixture used.

Should the part "jump" into full contact with the fixture while the broach is moving, tooth breakage is almost certain to occur since the part would have a tendency to cock and jam against the broach. In the case of a hole broach, the broach itself may be broken off in addition to tooth breakage.

Broach Sharpening

Proper resharpening of broaches will prolong the life of the tool and will also help keep satisfactory production unimpaired, both as to quantity of parts produced and their conformance to specified dimensions and finish. Resharpening should be undertaken with the object of restoring the cutting edges of the broach to their original condition.

Best results can be obtained only if the special equipment developed for this purpose is used. Makeshift or improvised equipment cannot be expected to produce the accuracy and finish that can be obtained with the special broach sharpening machines now available. Such sharpening equipment should be kept in first-class condition and should be operated only by men familiar with the essential requirements of the broach sharpening operation. Satisfactory broach performance and length of life can be obtained only if the cutting edges are maintained as originally designed. Any marked departure from the original form of the teeth will result in incorrect cutting action and possible irreparable damage. Special gages, Figures 17 and 17-A, are available for checking tooth form for correctness after grinding.

Only enough metal should be ground from the face of a tooth to bring that particular tooth to the desired sharpness. Treat each tooth as an individual grinding job and sharpen accordingly, Figures 14, 15 and 16. Only for special types of broaches where the step per tooth is graduated to close limits is it necessary to grind exactly the same amount of metal from the faces of all the teeth.

It is also important in the sharpening operation to use the correct type of grinding wheel. The wheel size, grain, and grade all have a bearing on the speed of sharpening, prevention of burning the steel, glazing the wheel, etc., just as in other tool sharpening operations.

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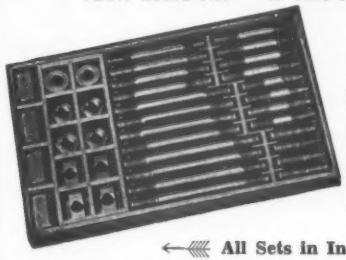

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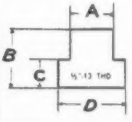

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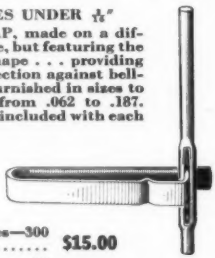

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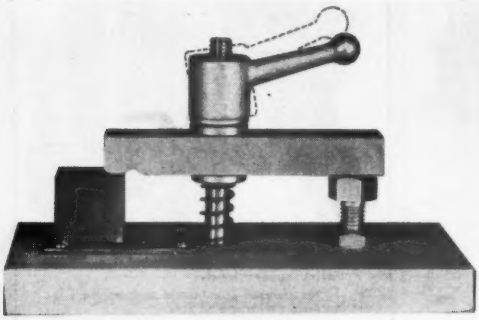
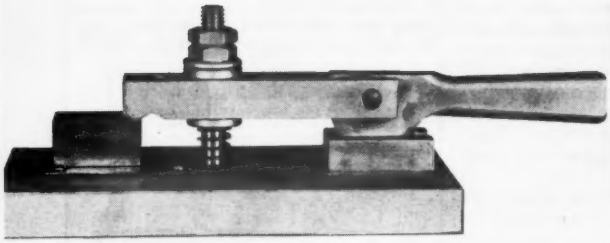
Portfolio containing actual size drawings and prices will be sent on request.

QUARTER TURN "LIGHTNING" CLAMP ASSEMBLY. Positive clamping . . . instant release . . . 1045 forged steel clamp lever . . . ground thread alloy steel stud . . . available in 27 size combinations. Ask us for free demonstration by one of our representatives.





CAM HEEL CLAMP ASSEMBLY. Positive clamping with cushion action . . . will not creep . . . instant release . . . vibration will not release cam lever . . . available in 21 size combinations. Ask for free demonstration by one of our representatives.

"27 VARIETIES"

The Chrome Plated Line

Adjusting Head Screws
Adjusting Half Nuts
C-Washers
Cam Action Clamps
Clamp Rests
Flange Nuts
Gang Mill Fixture Bases
Ground Thread Studs
Heel Clamps
Heel Clamp Assemblies
Hand Knob Clamp Assemblies
Hand Knob Clamps
Hex Jig Feet
Jig Feet
Knob Shoe Assemblies
Mill Fixture Bases
Quarter Turn "Lightning" Clamps
Quarter Turn Screws
Rectangular Box Jigs
Square Box Jigs
Stud Drivers
Swing Bolts
Swing Clamps
Spherical Washers
Socket Head Shoulder Screws
T-Angle Plate Fixtures
Precision V Blocks

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Science • Research • Methods • Tooling • Production • Trade News and Reports

The Allegheny Ludlum Award

A newly adopted form of recognition for "distinguished service and outstanding achievement" among executives and employees of Allegheny Ludlum Steel Corporation has been presented to four men by Hiland G. Batcheller, company president.

The award was presented to Vere B. Browne, vice-president in charge of research and a member of the board; Walter M. Patterson, manager of the electric furnace department at the company's Brackenridge, Pa., mill; David P. Bartell, chief chemist at Brackenridge, and Walter Miscosky, of the Brackenridge chemical laboratory.

While Mr. Browne and Mr. Patterson received individual awards—each of which consists of the "president's medal," a certificate, and a $1000 cash award—Mr. Bartell and Mr. Miscosky divided the third award for their joint "extraordinary accomplishments in reducing the time required to determine the chemical analysis of alloy steels."

Mr. Browne, who became associated with the Allegheny Steel Company in 1909 as chief chemist and rose to the position of vice-president in 1930, was cited for "continuous contributions to the art of making magnetic, stainless and other alloy steels . . . benefiting not only the corporation but all industry; and for the valuable assistance he has rendered customers in the application of the alloy steels developed by him or under his direction."

Mr. Patterson began work with the company as third helper in the open-hearth department of the Brackenridge mills in 1922. He was honored for "continuous accomplishment in the field of electric furnace operations."

Mr. Bartell and Mr. Miscosky were honored for finding a means of obtaining more quickly the chemical analysis of alloy steels.

The Allegheny Ludlum award, adopted recently by the board of directors, is presented to those nominated by superiors and approved by board action. The "president's medal," a four inch bronze medallion, carries on one side the phrase: "Presented to — — —, to honor distinguished service and achievement." The opposite side bears the title: "President's Medal" and the relief of a steel worker.

M.I.T. President Cites Need for Engineers

Future demand for engineering graduates will be more than twice as great as before the war, according to Karl T. Compton, president of Massachusetts Institute of Technology.

"Despite increased military and civilian demands during the war, the number graduating from engineering schools," he declared, "has declined steadily to a low this year of less than 7,000, including those in Army and Navy sponsored programs. This compares with a normal complement early in the war of almost 15,000."

In an article appearing in Educational Focus, Bausch & Lomb Optical Co. publication issued Nov. 11, Dr. Compton predicted that the nation's deficiency in technical manpower "will not be wiped out until 1952 at the earliest."

Dr. Compton pointed out that during the war virtually all of the technical talent focused its attention on the development of equipment and techniques for winning the war.

"Even though a great deal of this research will have peacetime application, we have undoubtedly lost ground in our

constructive efforts constantly to improve the standard of living. Further, we have drawn heavily on our reservoir of fundamental scientific knowledge because most of the war research concerned the application of science and any basic research was incidental to the major task. We must therefore promptly replenish the supply of the 'raw materials' of engineering and science."

The M.I.T. president added that during the war almost every company producing war equipment was dependent in some way on technical manpower. "That this trend will continue in peacetime is borne out strikingly by a survey recently conducted among 125 companies throughout the United States by a committee of the American Society of Engineering Education. The results indicate that the future annual demand for engineering graduates will be more than twice as great as before the war."

In conclusion, Dr. Compton declared that the future for the young man in engineering or science is "indeed bright"; that it presents "a challenge and an opportunity that we should not and cannot let pass."

"Educators and industrialists alike must do everything possible to encourage students at the secondary school level to study basic sciences and to develop in the students an interest in a future career in one of the technical fields."

He commended industrial companies for their efforts in stimulating interest through science awards and scholarships given each year to promising young men and women and cited the Bausch & Lomb Honorary Science Award Medal and Science Scholarships, and the Westinghouse Talent Search, "as two examples of awards which annually attract nationwide attention."

Apprenticeship Programs Up 164 Percent

The number of establishments with registered apprenticeship programs in the skilled trades in the United States has increased by more than 164 percent from the end of September, 1945, to the end of September of this year, according to William F. Patterson, Director, Apprentice-training Service, U. S. Department of Labor.

Speaking at a conference of the American Society of Training Directors at Newcastle, Pennsylvania, Mr. Patterson declared the number of establishments with registered apprenticeship programs increased from 25,800 at the end of September, 1945, to 68,200 at the end of September, 1946.

He also cited other increases in apprenticeship: local registered apprenticeship systems jumped from 4,840 in September, 1945, to 11,985 in September, 1946, and local joint management-labor apprenticeship committees from 1,894 to 3,843 during the same period. "Registered" systems and establishments, he explained, are those approved by and listed with a State or Federal apprenticeship agency.

Mr. Patterson gave the following reasons for the great expansion of apprenticeship: during the depression years when many journeymen were out of work, industry lost sight of the need of training apprentices for normal production; during the war the armed forces took practically all young men who might have taken apprentice training, the lack of skilled workers in some trades today, and the record production program anticipated for which thousands of more craftsmen will be needed.

During the past 12 months national apprenticeship standards have been established for four trades in the construction industry: bricklaying, plastering, cement finishing, and roofing. This brings to ten the number of trades in the construction industry for which such national apprenticeship standards have been set up. All ten were formulated by committees equally representative of national contractor and labor organizations. These national standards are patterns for setting up local apprenticeship systems, and specify that an apprentice be given training in all the skills of his trade, and that he be given related classroom instruction, wages to be paid, and that these and other pertinent matters be covered by a written agreement, Mr. Patterson said.

Abuses in training programs for veterans which resulted in the enactment of Public Law 679, an amendment to the

G. I. Bill, have not been reported to ATS as being in apprenticeship, but were found in other types of short-term, on-the-job training, he stated.

Because Public Law 679 has reduced the subsistence allowance a veteran in on-the-job training and in apprenticeship may receive, applications are being received to have additional occupations recognized as apprenticeable trades, Mr. Patterson said. He pointed out that this recognition is being sought as financial assistance from the Government is available for no more than two years to on-the-job trainees, while apprentices may receive this money up to four years. Warning that State agencies vested with the authority to approve establishments for veterans' training under the G.I. Bill should be extremely careful in examining these applications before recognition is granted that jobs be recognized as apprenticeable, Mr. Patterson said:

"Industry, the veterans and our country will suffer if we do not maintain present high standards of the skilled trades. These standards for the training of craftsmen made it possible for our nation to produce high quality merchandise and raised the journeyman to the top rank in the labor force."

Engineering Foundation

The Engineering Foundation, at the annual meeting of its Board, re-elected Dr. A. B. Kinzel, internationally known metallurgist, as Chairman for the coming year. Dr. Kinzel is Vice-President of the Union Carbide and Carbon Research Laboratories, Inc., and of the Electro Metallurgical Company.

Other officers elected were: Dr. L. W. Chubb, Director of the Westinghouse Research Laboratories, as Vice-Chairman; Dr. Edwin H. Colpitts, formerly Vice-President of the Bell Telephone Laboratories, re-elected Director; and John H. R. Arms, re-elected Secretary. Dr. Kinzel will represent the Engineering Foundation on the Executive Board of the National Research Council.

Founded in 1914 by Ambrose Swasey of Cleveland, Ohio, the Engineering Foundation was established for "the furtherance of research in science and engineering and the advancement in any other manner of the profession of engineering and the good of mankind." He made five gifts intended to be the nucleus of a great "community trust" for engineers, to be augmented by the gifts of many donors.

The Engineering Foundation is one of the departments of the United Engineering Trustees, Inc., a corporation which was set up jointly by the four national engineering Founder Societies which have an aggregate membership of over 88,000. These societies are: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and American Institute of Electrical Engineers. The Engineering Societies' Library, with some 194,000 books and pamphlets, one of the largest collections on technical matters in the world, is also a department of the United Engineering Trustees, Inc.

Reports submitted at the meeting covered eleven research projects which the Engineering Foundation had aided during the past year. These projects involved research in such diversified fields as soil mechanics, hydraulics, alloys of iron, metal cutting, lubrication, rolling friction, welding and plastic flow of metals.

The report of the Chairman states that in selection of projects to be supported preference has continued to be given to those of a more fundamental nature which would not normally be undertaken by an industrial research organization. Where a project is of interest to a group of industries the Foundation has provided limited financial support and a sponsorship which enabled the main support of the project to be secured from industry or other sources. In general it would be understood the grant of the Foundation merely supplemented the contributions of the organization carrying on the research. Such contributions were space, testing facilities, technical direction of project, etc. Thus supplemented, relatively small grants from the Foundation were made most effective.

Hot-Work Dies Hard-Faced with HAYNES STELLITE Alloy

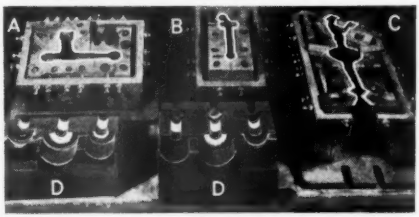
Outlasted Ordinary Dies from 3 to 6 times

HAYNES STELLITE hard-facing alloy greatly increased the life of these hot-work dies because it resists abrasive wear and retains its high hardness even at red heat.

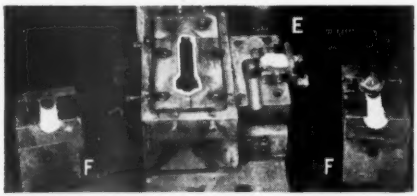
In addition, maintenance costs were reduced because dies had to be changed less frequently . . . and also because hard-faced dies could be repaired in half the time required to replace plain steel dies.

HAYNES STELLITE alloy is being used profitably in practically every industry. To decrease maintenance work . . . to reduce shutdown time . . . to maintain production . . . take full advantage of hard-facing. There is a HAYNES rod for every type of application. Write for the 104-page booklet, "Hard-Facing with Haynes Stellite Products."

Here's how hard-facing helped a large motor manufacturer . . .



	No. of Pieces Between Refittings	*Hours Required to Refit Die*
A—Hot-Trimming Die for Wheel Support	Steel—2,500 Hard-Faced—7,500	Steel—16 Hard-Faced—8
B—Hot-Trimming Die for Steering Crank	Steel—1,750 Hard-Faced—7,500	Steel—16 Hard-Faced—8
C—Hot-Trimming Die for Front Wheel Support Arm	Steel—2,500 Hard-Faced—7,500	Steel—40 Hard-Faced—20
D—Upsetting Die for Pinion Gear	Steel—5,000 Hard-Faced—25,000	Steel—40 Hard-Faced—70



E—Hot-Trimming Die for Steering Cross Shaft	Steel—3,500 Hard-Faced—15,000	Steel—28 Hard-Faced—10
F—Upsetting Die for Pinion Gear	Steel—3,500 Hard-Faced—25,000	Steel—28 Hard-Faced—70

HAYNES STELLITE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Chicago—Cleveland—Detroit—Houston—Los Angeles—
New York—San Francisco—Tulsa

HAYNES TRADE-MARK *alloys*

The registered trade-marks "Haynes" and "Haynes Stellite" distinguish products of Haynes Stellite Company.

TDJ SHOP DATA SHEET NO. 55

Safe Feeds and Speeds for High Speed Drills

Drill Dia.	Cast Iron		Bronze or Brass		Drop Fgs. Alloy Steel Tool Steel Annealed		Drop Fgs. Alloy Steel Heat Treated		Steel Castings		Mild Steel	
	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed
1/16	.002	4550	.002	9150	.002	3650	.002	2750	.002	3650	.002	4250
	.004	6700	.004	12000	.003	4550	.003	3650	.003	4550	.003	5600
1/8	.002	2550	.002	4550	.002	1800	.002	1225	.002	1800	.002	2100
	.004	3350	.004	5600	.003	2250	.003	1800	.003	2250	.003	2800
3/16	.004	1500	.004	3100	.003	1200	.003	900	.003	1200	.003	1400
	.006	2200	.007	5600	.004	1500	.004	1200	.005	1500	.005	1900
1/4	.004	1150	.004	2300	.003	925	.003	750	.003	925	.003	1050
	.006	1650	.007	2750	.004	1150	.004	925	.005	1150	.005	1500
5/16	.006	925	.007	1825	.004	725	.004	500	.004	725	.005	850
	.009	1325	.010	2200	.006	925	.005	725	.006	925	.007	1200
3/8	.006	750	.007	1525	.004	600	.004	400	.004	600	.005	700
	.009	1100	.010	1850	.006	750	.005	600	.006	750	.007	925
7/16	.009	650	.010	1300	.006	525	.005	350	.006	525	.006	600
	.012	950	.014	1525	.009	650	.006	525	.010	650	.010	800
1/2	.008	575	.010	1150	.006	375	.005	300	.006	375	.006	525
	.012	850	.014	1375	.009	575	.006	375	.010	575	.010	700
9/16	.012	500	.014	1000	.008	350	.007	275	.010	350	.010	575
	.016	750	.018	1200	.012	500	.010	350	.014	500	.014	625
5/8	.012	450	.014	900	.008	300	.007	250	.010	300	.010	425
	.016	675	.018	1100	.012	450	.010	300	.014	450	.014	565
11/16	.012	410	.014	800	.008	275	.007	225	.010	275	.010	375
	.016	625	.018	1000	.012	410	.010	275	.014	410	.014	525
3/4	.012	375	.014	750	.008	250	.007	200	.010	250	.010	350
	.016	550	.018	900	.012	375	.010	250	.014	375	.014	475
13/16	.014	350	.016	700	.010	240	.009	190	.014	240	.014	325
	.020	525	.022	850	.014	350	.012	240	.016	350	.016	450
7/8	.014	325	.016	650	.010	225	.009	175	.014	225	.014	300
	.020	475	.022	800	.014	325	.012	225	.016	325	.016	400
15/16	.014	300	.016	625	.010	200	.009	160	.014	200	.014	275
	.020	450	.022	725	.014	300	.012	200	.016	300	.016	375
1"	.014	280	.016	575	.010	185	.009	150	.014	185	.014	265
	.020	425	.022	675	.014	280	.012	185	.016	280	.016	350

Assume a ½" hole is to be drilled in a heat treated drop forging. Follow the column headed Drop Forging, Heat Treated, down to where it meets the ½" drill line. There it will be found that a feed .005 to .006 and a speed of from 300 to 375 rpm are recommended. Start by using .005 feed and 300 rpm. If the drill and machine seem to run smoothly without strain, then both feed and speed can be advanced. The speeds and feeds apply to average working conditions and materials.

Courtesy of the Chicago Latrobe Twist Drill Works, 411 West Ontario St., Chicago 10, Ill.

TDJ SHOP DATA SHEET NO. 56

Equivalent Drill Sizes

Fraction and No.	Decimal	Metric
	.0039	.10
	.0059	.15
	.0079	.20
	.0098	.25
	.0118	.30
80	.0135	
	.0138	.35
79	.0145	
1/64	.0156	
	.0157	.40
78	.0160	
	.0177	.45
77	.0180	
	.0197	.50
76	.0200	
75	.0210	
	.0217	.55
74	.0225	
	.0236	.60
73	.0240	
72	.0250	
	.0256	.65
71	.0260	
	.0276	.70
70	.0280	
69	.0292	
	.0295	.75
68	.0310	
1/32	.0312	
	.0315	.80
67	.0320	
66	.0330	
	.0335	.85
65	.0350	
	.0354	.90
64	.0360	
63	.0370	
	.0374	.95
62	.0380	
61	.0390	
	.0394	1.00
60	.0400	
59	.0410	
	.0413	1.05
58	.0420	
57	.0430	
	.0433	1.10
	.0453	1.15
56	.0465	
3/64	.0469	
	.0472	1.20
	.0492	1.25
	.0512	1.30
55	.0520	
	.0531	1.35
54	.0550	
	.0551	1.40
	.0571	1.45
	.0591	1.50

Fraction and No.	Decimal	Metric
53	.0595	
	.0610	1.55
1/16	.0625	
	.0630	1.60
52	.0635	
	.0650	1.65
	.0669	1.70
51	.0670	
	.0689	1.75
50	.0700	
	.0709	1.80
	.0728	1.85
49	.0730	
	.0748	1.90
48	.0760	
	.0768	1.95
5/64	.0781	
47	.0785	
	.0787	2.00
	.0807	2.05
46	.0810	
45	.0820	
	.0827	2.10
	.0846	2.15
44	.0860	
	.0866	2.20
	.0886	2.25
43	.0890	
	.0906	2.30
	.0925	2.35
42	.0935	
3/32	.0938	
	.0945	2.40
41	.0960	
	.0965	2.45
40	.0980	
	.0984	2.50
39	.0995	
38	.1015	
	.1024	2.60
37	.1040	
	.1063	2.70
36	.1065	
7/64	.1094	
35	.1100	
	.1102	2.80
34	.1110	
33	.1130	
	.1142	2.90
32	.1160	
	.1181	3.00
31	.1200	
	.1220	3.10
1/8	.1250	
	.1260	3.20
	.1280	3.25
30	.1285	
	.1299	3.30
	.1339	3.40

Fraction and No.	Decimal	Metric
29	.1360	
	.1378	3.50
28	.1405	
9/64	.1406	
	.1417	3.60
27	.1440	
	.1457	3.70
26	.1470	
	.1476	3.75
25	.1495	
	.1496	3.80
24	.1520	
	.1535	3.90
23	.1540	
5/32	.1562	
22	.1570	
	.1575	4.00
21	.1590	
20	.1610	
	.1614	4.10
	.1654	4.20
19	.1660	
	.1673	4.25
	.1693	4.30
18	.1695	
11/64	.1719	
17	.1730	
	.1732	4.40
16	.1770	
	.1772	4.50
15	.1800	
	.1811	4.60
14	.1820	
13	.1850	4.70
	.1870	4.75
3/16	.1875	
12	.1890	4.80
11	.1910	
	.1929	4.90
10	.1935	
9	.1960	
	.1968	5.00
8	.1990	
	.2008	5.10
7	.2010	
13/64	.2031	
6	.2040	
	.2047	5.20
5	.2055	
	.2067	5.25
	.2087	5.30
4	.2090	
	.2126	5.40
3	.2130	
	.2165	5.50
7/32	.2187	

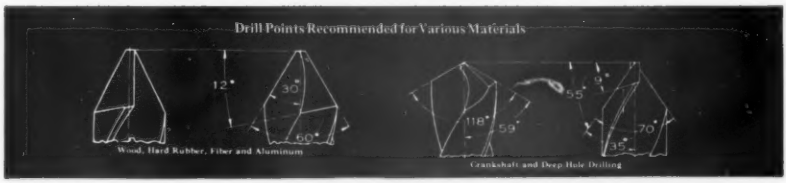
TDJ SHOP DATA SHEET NO. 57

Equivalent Drill Sizes

Fraction No. and Letter	Decimal	Metric
7/32	.2187	
	.2205	*5.6*
2	.2210	
	.2244	*5.7*
	.2264	*5.75*
1	.2280	
	.2283	*5.8*
	.2323	*5.9*
A	.2340	
15/64	.2344	
	.2362	*6.0*
B	.2380	
	.2402	*6.1*
C	.2420	
	.2441	*6.2*
D	.2460	
	.2461	*6.25*
	.2480	*6.3*
1/4	.2500	
E	.2500	
	.2520	*6.4*
	.2559	*6.5*
F	.2570	
	.2598	*6.6*
G	.2610	
	.2638	*6.7*
16/64	.2656	
	.2657	*6.75*
H	.2660	
	.2677	*6.8*
	.2717	*6.9*
I	.2720	
	.2756	*7.0*
J	.2770	
	.2795	*7.1*
K	.2810	
9/32	.2812	
	.2835	*7.2*
	.2854	*7.25*
	.2874	*7.3*
L	.2900	
	.2913	*7.4*
M	.2950	
	.2953	*7.5*
19/64	.2969	
	.2992	*7.6*
N	.3020	
	.3031	*7.7*
	.3051	*7.75*
	.3071	*7.8*
	.3110	*7.9*
5/16	.3125	
	.3150	*8.0*
O	.3160	
	.3189	*8.1*

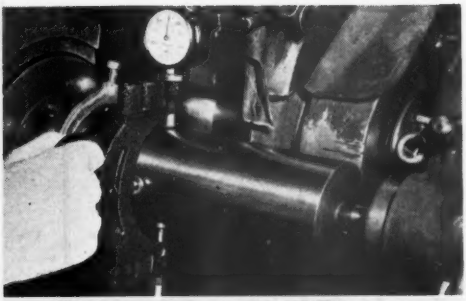
Fraction No. and Letter	Decimal	Metric
	.3228	*8.2*
P	.3230	
	.3248	*8.25*
	.3268	*8.3*
21/64	.3281	
	.3307	*8.4*
Q	.3320	
	.3346	*8.5*
	.3386	*8.6*
R	.3390	
	.3425	*8.7*
11/32	.3437	
	.3445	*8.75*
	.3465	*8.8*
S	.3480	
	.3504	*8.9*
	.3543	*9.0*
T	.3580	
	.3583	*9.1*
23/64	.3594	
	.3622	*9.2*
	.3642	*9.25*
	.3661	*9.3*
U	.3680	
	.3701	*9.4*
	.3740	*9.5*
3/8	.3750	
V	.3770	
	.3780	*9.6*
	.3819	*9.7*
	.3839	*9.75*
	.3858	*9.8*
W	.3860	
	.3898	*9.9*
25/64	.3906	
	.3937	*10.0*
X	.3970	
Y	.4040	
13/32	.4062	
Z	.4130	
	.4134	*10.5*
27/64	.4219	
	.4331	*11.0*
7/16	.4375	
	.4527	*11.5*
29/64	.4531	
15/32	.4687	
	.4724	*12.0*
31/64	.4844	
	.4921	*12.5*
1/2	.5000	
	.5118	*13.0*
33/64	.5156	
17/32	.5312	
	.5315	*13.5*

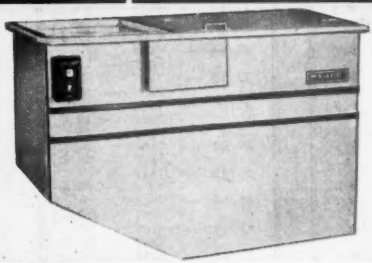
Fraction No. and Letter	Decimal	Metric
35/64	.5469	
	.5512	*14.0*
9/16	.5625	
	.5709	*14.5*
37/64	.5781	
	.5905	*15.0*
19/32	.5937	
39/64	.6094	
	.6102	*15.5*
5/8	.6250	
	.6299	*16.0*
41/64	.6406	
	.6496	*16.5*
21/32	.6562	
	.6693	*17.0*
43/64	.6719	
11/16	.6875	
	.6890	*17.5*
45/64	.7031	
	.7087	*18.0*
23/32	.7187	
	.7283	*18.5*
47/64	.7344	
	.7480	*19.0*
3/4	.7500	
49/64	.7656	
	.7677	*19.5*
25/32	.7812	
	.7874	*20.0*
51/64	.7969	
	.8071	*20.5*
13/16	.8125	
	.8268	*21.0*
53/64	.8281	
27/32	.8437	
	.8464	*21.5*
55/64	.8594	
	.8661	*22.0*
7/8	.8750	
	.8858	*22.5*
57/64	.8906	
	.9055	*23.0*
29/32	.9062	
59/64	.9219	
	.9252	*23.5*
15/16	.9375	
	.9449	*24.0*
61/64	.9531	
	.9646	*24.5*
31/32	.9687	
	.9842	*25.0*
63/64	.9844	
1.	1.0000	

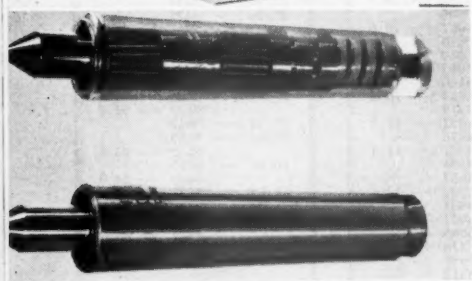


PROGRESS

NEW DEVELOPMENTS • IMPROVEMENTS • COST AND TIME SAVERS







FOR FURTHER INFORMATION FILL IN KEY NUMBERS ON POSTAGE-FREE INFORM-A-GRAM INSERT

COVERING A RANGE OF 4 INCHES, the Decimatic Dial Snap Gage features demountable heads and extension spacers. Using a popular sized Decimatic indicator, these instruments show highly consistent repeatability, are free from whip and waver of the hand, and are easily set to a master. Both gaging pins are surfaced with cemented carbide to reduce wear. Additional information is available on request from STANDARD GAGE CO., INC., Dept. 76, Poughkeepsie, N. Y., or use INFORM-A-GRAM Key No. B78-S.

REQUIRING ONLY SIMPLE, EASILY REPLACEABLE PARTS and very little maintenance, the new dip-agitating metal cleaning machine developed by the Mabor Company works at great speed, readily handling either a light or heavy load. Available in many sizes, it can be heated with steam, gas, oil, or electricity. More data can be requested from THE MABOR CO., Dept. 93, Clark Township, 10 Walnut St., Rahway, N. J., or use INFORM-A-GRAM Key No. J93-S.

HIGH PRODUCTION REQUIREMENTS, brought about by use of sintered carbide tools, are met with the Concentric Live Center, because it automatically compensates for heat expansion of workpiece without making tailstock adjusting necessary. The reduction in overhang eliminates chatter. Information on this live center, that operates under heavier radial and axial load at increased speeds, is available from GENERAL ALLIED METALS COMPANY, Dept. TDJ, 220 N. Front St., Burbank, Calif., or use INFORM-A-GRAM Key No. J63-S.

INSPECTION OF SMALL PARTS IS CONVENIENT for the new Electronic Snap Gage. The Gage Head, which is held in place by snap frames, can be mounted and locked in any vertical position on a stand. Standard sizes are up to 3 inches with a 1 inch range; larger sizes can be furnished. Write THE YANKEE PRECISION PRODUCTS CO., Dept. TDJ, 50 Bartholomew Ave., Hartford 6, Conn., for other data on this snap gage or use INFORM-A-GRAM Key No. C74-S.

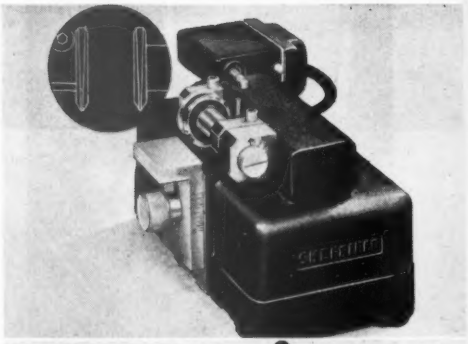
ON PARADE

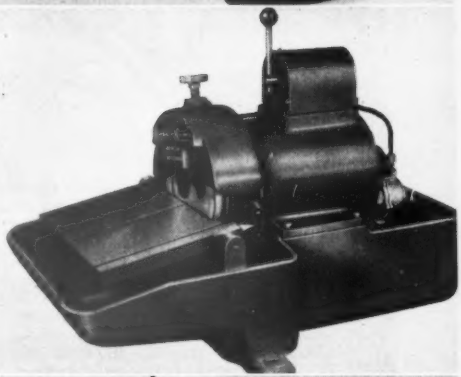
MAKING IT POSSIBLE TO CHECK THREAD LEAD within a range of 4½ to 60 threads per inch, adjustable truncated cylindrical gaging anvils are part of the production "Leadchek" manufactured by the Sheffield Corporation. This instrument can accommodate a wide diametrical range of thread work parts, is easily set up and changed over, and gives rapid precise measurement of the lead. Write for further details to the SHEFFIELD CORP., Dept. 24, Dayton, Ohio, or use INFORM-A-GRAM Key No. 24-S.

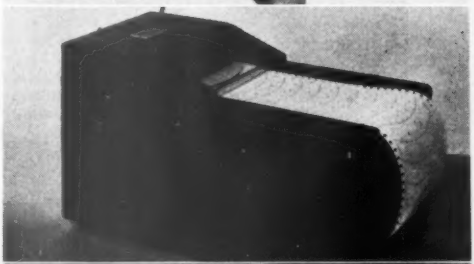
SHARPENING CARBIDE TOOLS with a steel-bound diamond wheel is the function of the Wickman-Neven Bench Grinding and Lapping Machine. The special 1 hp spindle motor provides ample power and withstands very frequent reversal. A coolant pump and reservoir are provided, together with angularly-adjustable table and swiveling wheel guard. Full details are given in a bulletin available from THE WICKMAN CORPORATION, Dept. 5-26, 15533 Woodrow Wilson Ave., Detroit 3, Mich., or use INFORM-A-GRAM Key No. 526-S.

RECORDING ROUGHNESS MEASUREMENT OF A PART is the purpose of the new Profilometer Reading Recorder. Operating as an attachment to the Profilometer, it provides a continuous chart record of the average roughness of the surface being measured. The charts, which are read in microinches, are useful in obtaining more detailed information on surface roughness, such as location of rougher or smoother areas, and in supplying customers with records of the surface finish on parts delivered to them. For full information write PHYSICISTS RESEARCH CO., Dept. 9, Ann Arbor, Mich., or use INFORM-A-GRAM Key No. 773-S.

FILLING A LONGFELT NEED FOR A HAMMER TYPE TOOL for removing scale and rust on welded parts, a new air powered peening and scaling hammer is being manufactured by the Aro Equipment Corp. Though this tool delivers 5,000 blows per minute, it does not distort light sheet metal when removing scale. This small, light weight tool will be described further upon request by THE ARO EQUIPMENT CORP., Dept. 1-95, Bryan, Ohio, or use INFORM-A-GRAM Key No. 195-S.





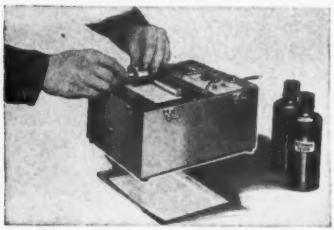


PROGRESS ON PARADE

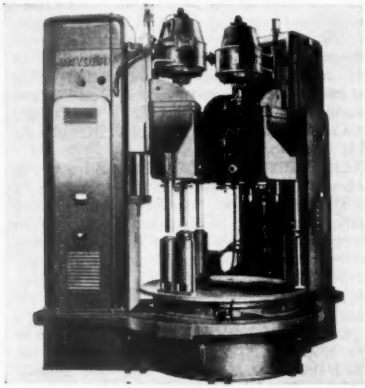
ENGINEERED FOR ALL-PURPOSE HOBBY AND HOME mechanical needs, the new improved Casco Electri-Craft Tool Kit gives

smooth, vibrationless operation, utilizing shock absorbing ball thrust and bearings. Dynamically balanced, the Casco tool is a complete power workshop equipped with 36 interchangeable tool accessories for work with wood, metal, plastics and glass. Further information is available from the CASCO PRODUCTS CORPORATION, Dept. 90, Bridgeport, Conn., or use INFORM-A-GRAM Key No. J90-S.

REPRODUCING ON METAL IN ONE TO THREE SECONDS, any mark or line appearing on a stencil film, the Ideal E-Z Mark Etcher is primarily designed for production marking. Film stencil impressions can be made by typewriter, pen, pencil, or stylus, and a single film can well make several hundred reproductions. Complete information may be obtained from IDEAL INDUSTRIES, INC., 4151 Park Ave., Sycamore, Ill., or use INFORM-A-GRAM Key No. H30-S.

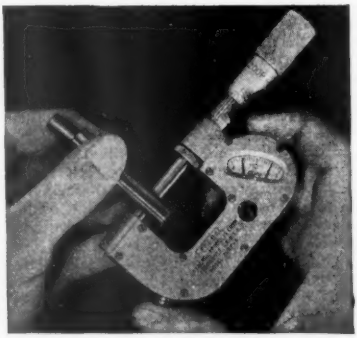


ROUGH AND FINISH BORING of compressor casings and cylinders, through a wide variety of sizes, is the purpose of this special machine designed by Snyder Tool & Engineering Co. The machine consists of a special welded steel base upon which are mounted two Snyder hydraulic column and platen assemblies and a manually operated index table. Each of the two-spindle boring heads is driven from an individual variable-speed



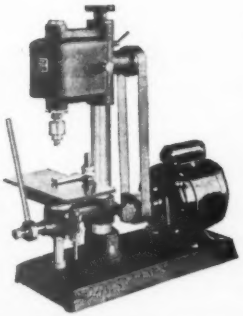
d-c motor. For complete details and other practical applications of this machine write SNYDER TOOL & ENGINEERING CO., Dept. 4-66, 3401 E. Lafayette, Detroit 7, Mich., or use INFORM-A-GRAM Key No. 466-S.

VISUALIZED MEASUREMENT ON A DIAL is incorporated in the new Federal Indicating Micrometer, increasing its value as a precision measuring instrument, and eliminating



TAPPING CAN BE *Fun*

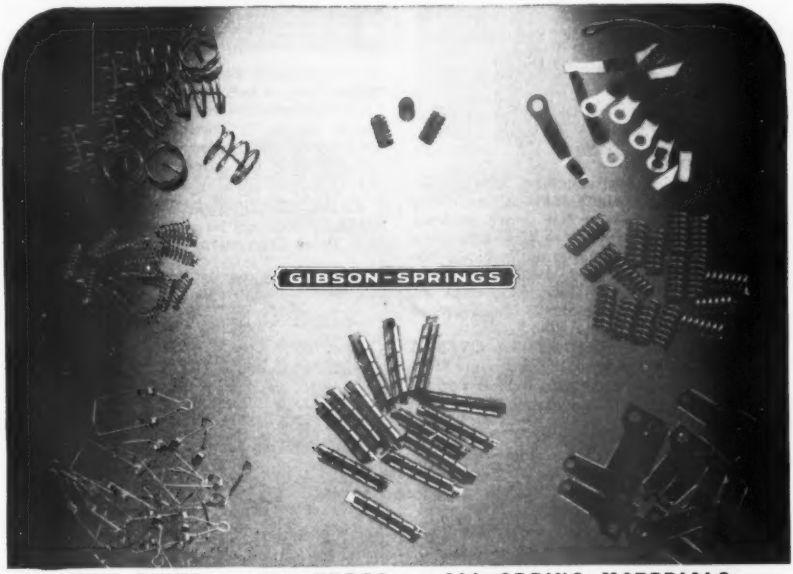
When tap breakage is reduced to an insignificant minimum; when spoilage is eliminated and more and more work "passes inspection"; when you standardize on the Hamilton Sensitive Tapping Machine, **tapping can be fun.** • Precision built by a firm that **knows** precision methods, this machine is yet rugged enough to take all of the abuse that intense production can inflict. • Capacity from the smallest and finest tap to 10-32 inclusive. Ample clearances and travel. **And** an attractive price. • Write for literature containing specifications and prices. Address Department C-T.



THE *Hamilton* TOOL COMPANY

SUPER SENSITIVE DRILLING MACHINES
TAPPING MACHINES · PORTELVATORS

NINTH STREET AT HANOVER · HAMILTON · OHIO · U·S·A

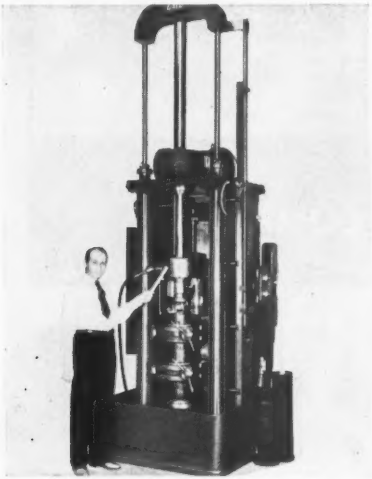


ALL SIZES . . . ALL TYPES . . . ALL SPRING MATERIALS

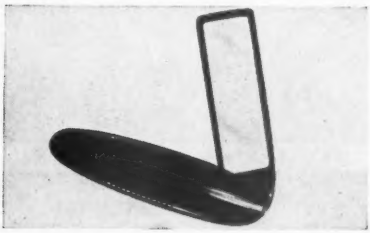
THE WILLIAM D. GIBSON CO. 1800 CLYBOURN AVE., CHICAGO 14, ILL.
(DIVISION OF ASSOCIATED SPRING CORPORATION)

errors of "feel" common to ordinary micrometers. This improved Federal Micrometer can be used as a comparator, or snap gage, as well as for direct measurement. Further data may be requested from FEDERAL PRODUCTS CORP., Dept. 4, 1144 Eddy St., Providence, R. I., or use INFORM-A-GRAM Key No. 4-S.

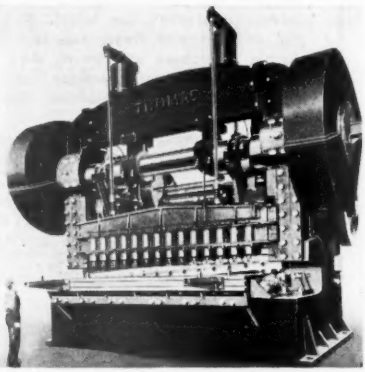
PRECISION ROUGH AND FINISH BORING of cylinders up to 40" in length and 6" to 8" in diameter is achieved by the Giern & Anholtt vertical boring machine, model TR. Rigid and accurate with spindle piloted above the work in a Gatco sealed rotary bushing, the unit is equipped to bore cast iron, steel or non-ferrous tubes using multiple blade boring cutter. Features and details are listed by GIERN & ANHOLTT TOOL CO., Dept. 44, 1311 Mt. Elliott Ave., Detroit 7, Mich., or use INFORM-A-GRAM Key No. J44-S.



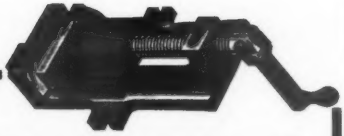
SECURING MAGNIFICATION OVER A LARGE AREA at a glance, the Longview Magnifier has a 4-inch long lens which permits close observation of fine detail work with less eye-strain from distortion or aberration. The finely ground and polished lens insures sharp accurate vision. Other information may be requested from EDROY PRODUCTS CO., Dept. 13, 480 Lexington Ave., New York 17, N. Y., or use INFORM-A-GRAM Key No. D13-S.



WITH CAPACITIES UP TO THREE INCHES IN THICKNESS and widths up to 14 feet and more, a newly improved line of mill-type plate shears is being made to users' specifications by the Thomas Machine Mfg. Co. Torsion is reduced by a twin drive on the main shaft. Other features are herringbone gears, friction clutch, double flywheels and pneumatic counter-balance cylinders. Write THOMAS MACHINE MFG. CO., Dept. 9-94, Pittsburgh 23, Pa., or use INFORM-A-GRAM Key No. 994-S.



FILING, CUTTING, SAWING, OR SLOTTING OPERATIONS can be performed on the Brown Drill Press Converter. It is adaptable to any



YOST DRILL PRESS VISE

This new Yost vise has been designed expressly for use on drill press operations. Does away with special and costly jig fixtures.

Offered in two sizes

Vise No.	Width of Jaw, Inches	Opens Inches	Weight Pounds
1D	3½	4	12½
2D	5	5½	28

Do you need a vise of ANY type?

Write today for bulletins on the extensive Yost line

YOST MFG. COMPANY
1000 MAIN ST.
MEADVILLE, PENNSYLVANIA

1846 One Hundred Years of Continuous Service to Industry **1946**

HY-TEN

SAE AISI

ALLOY STEELS

A century of experience in the development and application of special steels for PRODUCTION, TOOL ROOM, MAINTENANCE.

Seven warehouse stocks of rounds, flats, squares, hexagons, octagons. Forgings to specification.

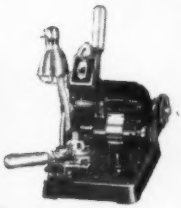
Write for our data sheet book.

WHEELOCK, LOVEJOY & CO., INC.
138 Sidney Street
CAMBRIDGE 39, MASS.
Cleveland 14, Chicago 23, Newark 5, Detroit 3, Buffalo 10, Cincinnati 22

Mill
SMALL PARTS
Fast • Accurately

with this

NEW *Rouse* HAND MILLER



$98 (Without Fixtures)
F.O.B. Chicago, Motor Extra

Rouse
Fixture Set-Ups that Speed Production.

It's a high-speed, motor-driven unit that has many uses in finishing operations for light cuts on aluminum, brass, steel and other metals . . . also, rounding and burring steel and cast iron. Inexperienced operators quickly learn to use it with speed and precision.

The Rouse Hand Miller, with Rouse Fixture Set-Ups, provides fast, accurate, low-cost milling for a big variety of small parts used in electrical work, instruments, aviation, communications and similar work.

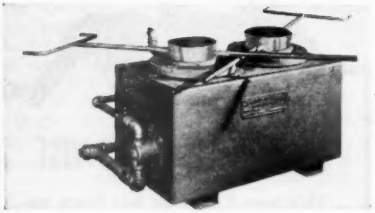
Available for immediate shipment. Write for illustrated circular and full details.

H. B. ROUSE AND COMPANY
2216 North Wayne Avenue Chicago 14, Illinois

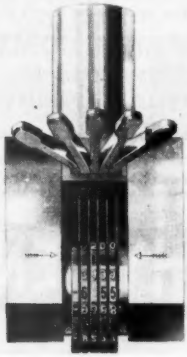
size or make of drill press and can be installed in a few minutes times. A solid steel cam mounted between two pre-loaded ballbearings converts the drill press rotary action to a vertical reciprocating action and simultaneously increases the drill press power output approximately 300%. Full details will be sent on request from LEO G. BROWN ENGINEERING CO., Dept. 38, 1157 Riverside Drive, Los Angeles, Calif., or use INFORM-A-GRAM Key No. J38-S.

PERMITTING THE UNIT TYPE DUST COLLECTOR TO HANDLE HEAVIER LOADS on polishing and buffing work, a high compression filter with new type seal and cyclone stack deflector has been added to the Dustkop dust collector. Lighter lint and dust not removed by cyclone separator collect under the filter and create a filter mat of their own. Suction at the intake hood diminishes when the mat has become thick and should be removed. More complete information will be sent on request from the AGET-DETROIT CO., Dept. 5-77, 617 First National Bldg., Ann Arbor, Mich., or use INFORM-A-GRAM Key No. 577-S.

ESPECIALLY DESIGNED FOR THE MODERATE PRODUCTION of pattern shops, schools, small foundries, and as supplemental equipment for large factories, the quick-melting Kindt-Collins Master Aluminum Melting Furnace is easily and economically operated at more than 100 heats. Aluminum can be melted in and poured directly from the heat-resisting alloy metal pot, thus minimizing agitation and resultant porosity. Specifications and prices can be obtained by writing the KINDT-COLLINS CO., Dept. 74, 12651 Elmwood Ave., Cleveland 11, Ohio, or use INFORM-A-GRAM Key No. D74-S.

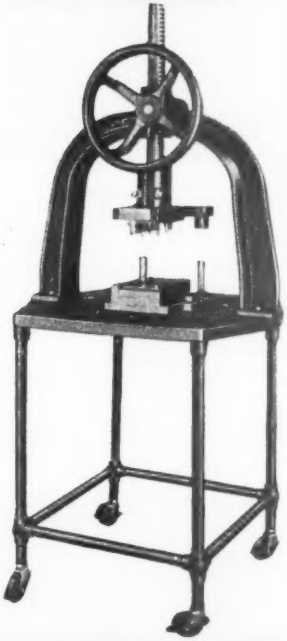


A SELECTIVE INDENTING NUMBERING HEAD designed so that each number wheel may be operator controlled by an individual lever has been announced by the Wm. A. Force & Co. Incorporating all features of the standard automatic numbering head except the action, this unit is adaptable for any small metal part on which numbering does not follow in direct sequence, but which require frequent changes. Special data about this device may be had upon request from WM. A. FORCE & CO., 2-93, 211 Nichols Ave., Brooklyn 8, N. Y., or use INFORM-A-GRAM Key No. 293-S.



GREATER FLEXIBILITY OF APPLICATION, HEAVIER CONSTRUCTION, filament voltage stabilizer, variable output control, circuit-breaker overload protection, water-pressure gage, time delay water system, and supervisory pilot-light control are among the many design features incorporated in the new electronic-type Model 1400 Ther-Monic high-frequency induction heating generators, manufactured by the INDUCTION HEATING CORPORATION. It is a versatile source of energy which can be used for brazing, soft soldering,

COMPLETE THE DIE-SET AT YOUR BENCH



LACEY DIE-SET MACHINE

Here is a truly "one man" press that operates with one hand and under full manual and visual control.

Handy for tool and press rooms, it permits the diemaker to complete a die-set *right at his bench* . . . saves tool room and handling costs.

Positive, true punch-to-die alignment is assured at all times, thanks to the Lacey's sturdy, open construction. And punches can be removed as often as needed without disturbing alignment once the die-shoe is clamped to the table and punch holder fixed in position in the ram. No pry bar or hammer is needed to separate punches.

The Lacey Die-Set machine is sensitive for delicate work yet rugged enough for fitting up heavy die-sets. Useful, too, for shearing certain types of punches.

Write today for complete details.

Sole Distributors

MOORE SPECIAL TOOL CO., INC.
740 Union Ave. Bridgeport 7, Conn.

TU-MY-CO

TRADE TUMICO MARK

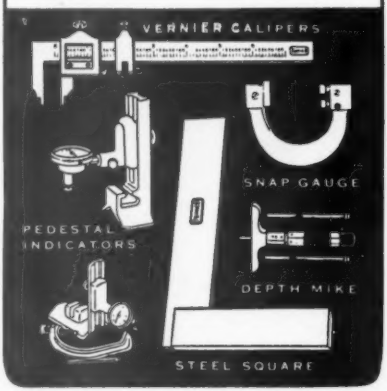
DEPTH GAGES

Designed for measuring holes, grooves, shoulders, etc., up to 3 inches in depth. Includes a set of interchangeable rods —1-inch, 2-inch and 3-inch, which are easily inserted and held to a positive seat by the knurled rod cap. There is an adjusting nut on each rod to compensate for wear.

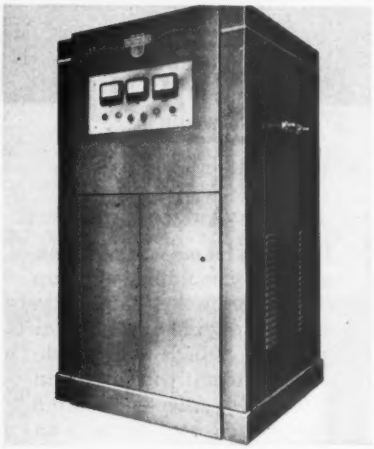
The case hardened steel base is furnished in either 2½" or 4" lengths. Ends of measuring rods are hardened, precision ground and lapped. Furnished with or without case. Ask your jobber.

WRITE FOR BULLETIN TD-D

TUBULAR MICROMETER CO.
ST. JAMES, MINNESOTA, U. S. A.
Milwaukee Branch • Plankinton Bldg.

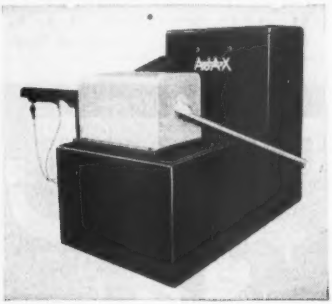


PROGRESS ON PARADE

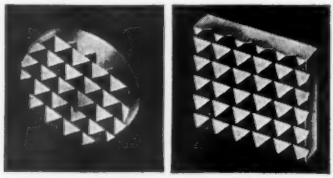


and fusing as well as for hardening, annealing, tempering, stress relieving, etc. Write for full details to the manufacturer, Dept. 96, 389 Lafayette St., New York, N. Y., or use INFORM-A-GRAM Key No. J96-S.

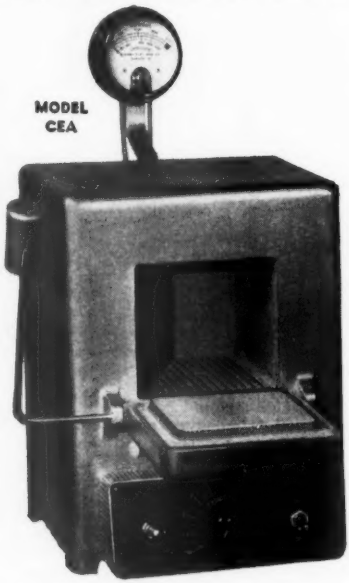
DESIGNED FOR CONTINUOUS AUTOMATIC HEATING OF STEEL SLUGS or forging blanks prior to forging operations, this new Ajax-Northrup induction heater ejects a white hot slug at just the right temperature, every few seconds. The unit, which features an automatically timed pneumatic feeding device, can easily be converted from one job to another simply by changing the heating coil proper, resetting the timing device and adjusting the feeding chute. Special details will be submitted upon request by AJAX ELECTROTHERMIC CORP., Dept. 63, Trenton 5, N. J., or use INFORM-A-GRAM Key No. D63-S.



DURABLE GRIPPING INSERTS, made of solid Kennametal for longer durability, are now being produced by Kennametal, Inc., for various holding, clamping, and feeding devices. In forms of discs and squares with diamond serrated surfaces, "Kengrips" are now available in four sizes. KENNAMETAL, INC., Dept. 33, Latrobe, Pa., will give further details, or use INFORM-A-GRAM Key No. 33-S.



OFFERING WIDER UTILITY FOR GENERAL LABORATORY USE and for production heat-treating of small parts, the new Model CEA



Electric Furnace will maintain a temperature of 2000° F continuously, and will automatically hold any temperature from 500° to 2000° F. The furnace is constructed of cast aluminum to combine great strength with lightness. More complete information can be obtained by writing to the THERMO ELECTRIC MANUFACTURING CO., Dept. 4-88, 480 W. Locust St., Dubuque, Iowa, or use INFORM-A-GRAM Key No. 488-S.

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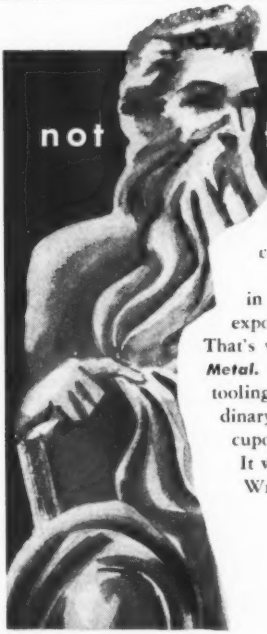

not for Michelangelo!

The sculptor sees a statue in a block of marble. His art consists of hewing away the stone and revealing the figure.

But die-making isn't "art for art's sake." There's no virtue in removing a lot of surplus material from a block of metal to expose a die.

That's why more and more dies are being contour-cast of ***Strenes Metal.*** Machining takes much less time, saving a large part of tooling cost. What's more, ***Strenes Metal*** dies produce an extraordinary number of stampings between redressings because each cupola charge is adapted to the individual requirement.

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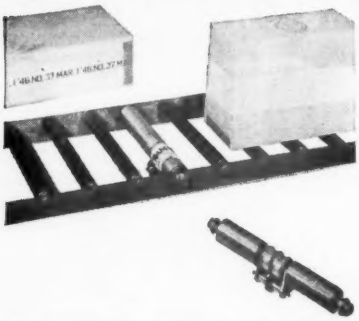
A WIDE VARIETY OF USES in industries requiring mixing, blending, tumbling, polishing, finishing, and similar operations, are executed by the Ransome Rotating Pan-Type

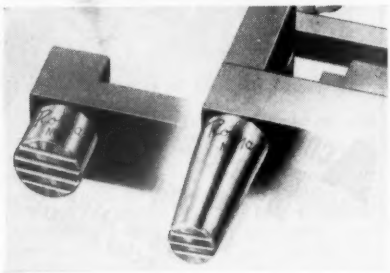
Mixer. The rotating pan is motor-tilted and motor-rotated at constant speed. With a 135° tilting range, materials are completely and cleanly discharged from the pan. Information can be obtained from RANSOME MACHINERY COMPANY, Dept. 4-37, 1470 South Second St., Dunellen, N. J., or use INFORM-A-GRAM Key No. 437-S.

AUTOMATICALLY IMPRINTING CASES as they pass over a roller conveyor, the "Rolacoder" marking machine places quick-drying permanent ink impressions approximately six



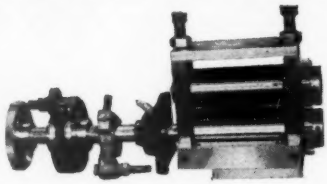
inches apart. Self-inking, the type cylinder is installed in the conveyor in place of one of the standard rollers. Description of the Rolacoder No. 50 outfit, which includes type and ink, will be sent on request by ADOLPH GOTTSCHO, INC., Dept. 44, Sales Office, 1 Hudson St., New York 13, N. Y., or use INFORM-A-GRAM Key No. 44-S.

ECONOMICAL PRODUCTION OF JIGS AND FIXTURES is facilitated by use of standardized legs and buttons. Rolyan legs and buttons have been designed to create a standard stock room item of this important jig and fixture accessory. With the wide range of sizes available, the draftsman merely specifies the required Rolyan leg or button by part number; thereby eliminating detailed drafting.



The knurled shanks assemble with a press fit in standard drill holes with no tedious fitting. Literature giving full information and specifications is available from L. C. KENNEY CO. (Succeeding Rolyan Metal Proudcts), Dept. 42, 5909 S. Western Ave., Chicago 36, Ill., or use INFORM-A-GRAM Key No. F42-S.

FEEDING STOCK INTO PUNCH PRESS DIES is facilitated by the Universal Roll Feed, which takes its power from the crankshaft of



the press by means of an adjustable eccentric. The only adjustment necessary to regulate the length of feed is made by means of an adjusting screw on the eccentric. The design of this roll feed incorporates a cam and roller type friction which is unaffected by grease and oil and will give the best service under normal operating conditions. Detailed information on this roll feed is available on request from the DURANT TOOL SUPPLY CO., Dept. 8, 155 Orange St., Providence 3, R. I., or use INFORM-A-GRAM Key No. J8-S.

ACCURATE PRODUCTION DRILLING OF SMALL HOLES in all drillable material is the designed purpose of The Hamilton Varimatic Super Sensitive Variable Speed Drilling Machine. Radically departing in design from the concepts of the past, the Varimatic offers flexibility and sensitivity, accuracy and

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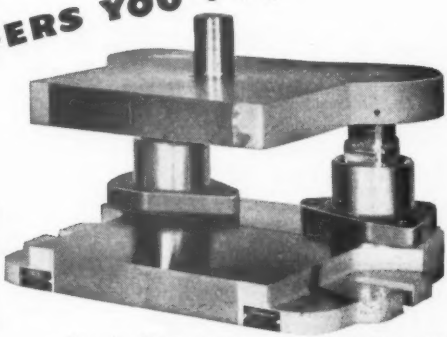
NEW SPEED and ACCURACY WITH MICROLEX ANTI-FRICTION DIE SETS . . .



Microlex Die Sets have ball or roller bearing guide pins which reduce die setter's time . . . enable you to get into production quicker . . . permit fast press speeds. Microlex Die Sets eliminate all down time caused by bound, scored or galled pins. Bearings have pre-load of .0015" to prevent play between guide pins and bushings.

You don't have to wait to cash in on the profitable advantages offered by Microlex Die Sets. A large number of sizes are ready for immediate shipment.

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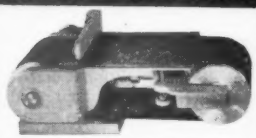

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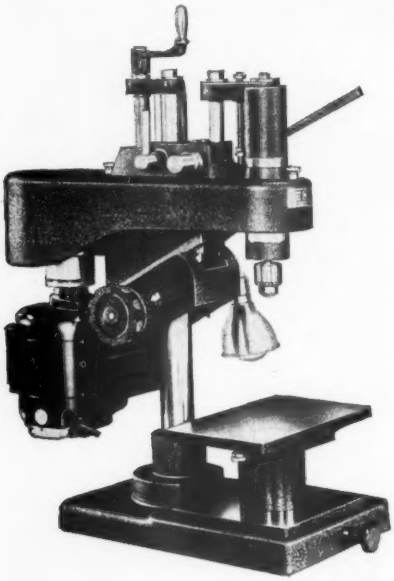
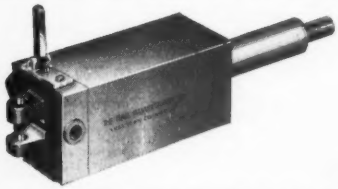
stamina far beyond the requirements of the average user. It has a drilling capacity of .004" to $\frac{5}{16}$", and variable speeds from 840



rpm to 9300 rpm through two speed ranges obtained by two-step drive and spindle pulleys. The drilling unit is self contained, swings radially on the column and locks to any position. All controls are manually operated. A 6½" vertical adjustment of the drilling unit is accomplished by means of an elevating screw. Complete description of the Varimatic is given in Bulletin V-47 now available on request from THE HAMILTON TOOL CO., Dept. 61, Ninth St. at Hanover, Hamilton, Ohio, or use INFORM-A-GRAM Key No. G61-S.

DESIGNED AND BUILT TO FIT the cus-



tomer's machine Fenn Custom-Built Air-Cylinders conform to the limitations of the machine's design without altering the power or the available pressure. All unnecessary packing is eliminated, thus reducing friction loss and maintenance costs, while adhering strictly to design specifications. For air economy these flexible Air-Cylinders are available in three types: single acting; double acting; and differential acting. All Fenn Cylinders are built to provide accurate control to the piston velocity curve according to needs, and can be cushioned at either or both ends of the stroke. For full details write the FENN MFG. CO., Dept. 2-91, 172 High St., Hartford 1, Conn., or use INFORM-A-GRAM Key No. 291-S.

REGULATING STROKE SPEED OF ANY AIR OR HYDRAULIC CYLINDER in both directions independently, the new 4-way Nopak Reciprotrol Valve permits a choice of cycles per minute, depending upon cylinder stroke and diameter. The built-in controls permit accurate regulation of the stroke-length from the full length of the piston rod to a small fraction thereof. The fractional cylinder stroke may be located, precisely, at any desired point within the full stroke length. Reciprotrol is adaptable to fully automatic, semi-automatic, or manual operation. Because it uses its own

exhaust to reverse its operating cycle with explosive speed, it permits up to 500 reciprocations per minute on small diameter, short-stroke air cylinders. Among a number of its applications, it can operate any size of double acting cylinder, operate two single-acting spring-return cylinders, or can be set up in batteries to actuate a large number of cylinders simultaneously in succession. The control shaft floats on airplane type "O" packings which require no oiling, but will endure for many millions of cycles. The ⅜" pipe size, in which the Reciprotrol Valve is built, makes it suitable for most oscillating applications. Complete details may be requested from the GALLAND-HENNING MFG. CO., Dept. 2-98, Milwaukee, Wis., or use INFORM-A-GRAM Key No. 298-S.

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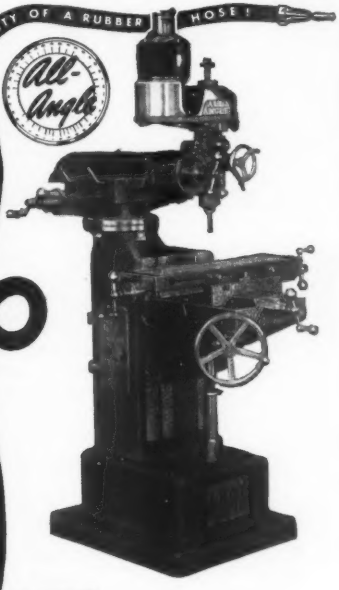
All-Angle



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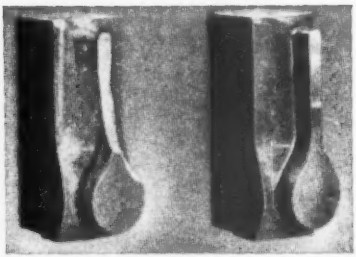
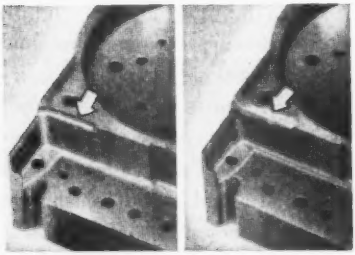
SAVE 3 WAYS

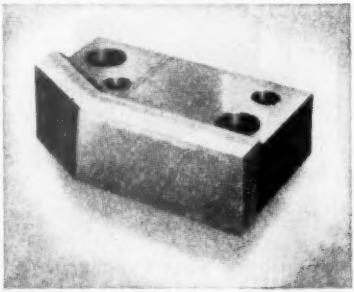
With *Eureka* Tool & Die Welding Electrodes



1 (Left) Save man hours, conserve material and minimize production delays by welding with EUREKA Tool and Die Electrodes. Die unit shown failed in operation but was quickly repaired by welding. No heat-treatment required.

2 (Right) For creating cutting edges or working areas in composite fabrication, EUREKA Electrodes are used with mild, medium, high carbon or S.A.E. steels as a base. No heat-treatment required.





3 (Left) EUREKA Tool & Die Welding Electrodes are used for correcting design by facilitating changes in contours, corners or edges during try-out or change-over periods, or for rectifying manufacturing errors, thus eliminating inserts.

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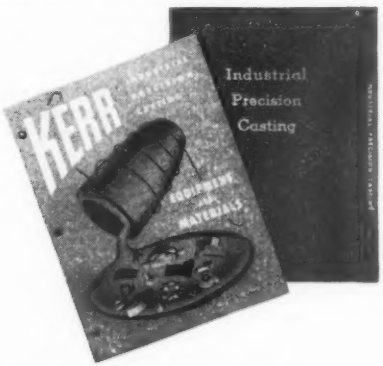
DESIGNED WITH COMPLETELY INTERCHANGEABLE PARTS, uniform standard construction and an extremely high factor of safety, the Portage No. 4 horizontal boring, drilling and milling machine readily provides speed, rigidity and accuracy of operation plus simply operated control and adjustment mechanisms. The many special attachments available for this machine render it adaptable to jobs with uncommon requirements. Study further details about the improved Portage attachments and mechanization in a descriptive and well-illustrated brochure available from PORTAGE MACHINE COMPANY, Dept. 13, Akron, Ohio, or use INFORM-A-GRAM Key No. A13-S.

COMPARING THE MODERN "LOST WAX METHOD" OF CASTING with a similar "lost art" employed by the Chinese over 2000 years ago, and discussing the specialized equipment necessary to achieve the close tolerances demanded by today's casting industry, two well-illustrated catalogs, "Fundamentals of Precision Casting" and "Precision Casting Equipment and Materials", with explanations reaching text-book clarity, are available from the KERR MFG. CO., Dept. 10, 6081 Twelfth St., Detroit 8, Mich., or use INFORM-A-GRAM Key No. K10-S.



WARTIME DEMANDS WERE RESPONSIBLE for the development of the Tatra Universal Boring Mill Angles, Double Deck (Perfect) Surface Plate, and "Famous" Super Speed (Perfect) Lapping Plates. These new angle plates, originally designed for Horizontal and Vertical Boring Mills and Jig Borers, were also adapted to lathes when holes in the face and footpad were added. Further data is clearly given in Bulletin No. 54, available from TATRA TOOL CO., Dept. 5, 16317 Sanford Ave., Cleveland 10, Ohio, or use INFORM-A-GRAM Key No. 5-R.

79 DIFFERENT OPERATIONS on wood, plastics and metal are facilitated by equipment produced by Frank Specialty Co., Inc. Among these are the double end Mighty-Master Polishing and Buffing Lathe, the "all purpose" Speed-O-Matic Midget-Master and Multi-Master Lathes designed to withstand continuous use, and a complete compact "all purpose" Unit. These, and a variety of "all purpose" attachments, are described and illustrated in literature available from FRANK SPECIALTY CO., INC., Dept. 2, 436 New Lots Ave., Brooklyn 7, N. Y., or use INFORM-A-GRAM Key No K2-S.

SPECIALLY DESIGNED SINGLE-POINT BORING AND INTERNAL THREADING TOOLS are manufactured by Bokum Tool Co. For plain boring, particularly efficient on lathes, is Style A; facing and bottoming tools, adaptable for use as recessing tools on high production jobs in automatics, are identified as Style B; the internal threading tools are cataloged Style C. All the tools are available in wide range of sizes. For further details, write BOKUM TOOL CO., Dept. 43, 14775 Wildemere, Detroit 21, Mich., or use INFORM-A-GRAM Key No. A43-S.

WAR DEVELOPED SYNTHETIC SAPPHIRE as a production tool has superior wear resistance. It has been used with success in the manufacture of jewel bearings for watches and aircraft instruments, for making precision

plug and ring gages, cutting tools, spray nozzles, burnishing wheels, insulators, and phonograph needles. For details of its characteristics and properties write ELGIN NATIONAL WATCH CO., SAPPHIRE PRODUCTS DIV., Plant No. 3, Dept. 89, 932 Benton St., Aurora, Ill., or use INFORM-A-GRAM Key No. C89-S.

IMPORTED FROM SWITZERLAND, THE ZYMA JIGBORER, particularly useful in pattern making, and the "Aceria" universal milling machine, specially designed for high precision work of small dimensions, are among the many machines listed in literature issued by the MAVEG, INC., MACHINE SALES ASSOCIATION. Complete information regarding these special machines can be obtained by writing the company, Dept. 97, 299 Broadway, New York 7, N. Y., or use INFORM-A-GRAM Key No. J97-S.

CONTINUOUS PRECISION SERVICE IN PRODUCTION, assembly lines, and maintenance work is accomplished with the new line of "Tru-Torque" Screw Drivers. Simple to operate, they have no dials to read or spring mechanisms, come in three standard sizes, and are excellent for factory or shop work. Request a catalog sheet describing and explaining them from AIRDRAULICS ENGINEERING, INC., Dept. 26, New Canaan, Conn., or use INFORM-A-GRAM Key No. J26-S.

PORTABLE ELECTRIC POWER TOOLS manufactured by the Mall Tool Co. are described and pictured in two handbooks recently issued. Form 441 reviews Mall saws, planes, drills, screwdrivers, and sanders; Form 437, grinders. Send for these pocket size 30-page reviews of Mall Tools. They are available, including price lists, from MALL TOOL CO., Dept. 380, 7740 S. Chicago Ave., Chicago 19, Ill., or use INFORM-A-GRAM Key No. 380-S.

AUTOMATIC WATER EJECTOR effectively removes water from the water separator or air lines, thus preventing water damage. By maintaining only clean, dry air in the system, it increases the service life, operating efficiency and productive capacity of all air-operated equipment. It cannot cause loss of air pressure and will remove one quart of water in 30 cycles of operation at 100 lbs pressure. NATIONAL PNEUMATIC CO., Dept. DJ, 420 Lexington Ave., New York 17, N. Y., will promptly send complete specifications. INFORM-A-GRAM Key No. G71-S.

COMBINING ACCURACY WITH ECONOMIC PRODUCTION, the Electro Mechano High Speed Precision Drill Press features simplified construction which is responsible for easy, fast operation, reduced drill breakage, little noise or vibration, and long life of the press. An illustrated brochure will be sent upon request from the ELECTRO-MECHANO CO., Dept. 79, 261 East Erie St., Milwaukee 2, Wis., or use INFORM-A-GRAM Key No. H79-S.

SAVING TIME, LABOR, AND COST which is usually lost through putting lock washers on screws, the Shakeproof, pre-assembled lock washer and screw is a single unit featuring a washer which cannot drop off, yet is free to rotate. It is manufactured in all standard styles and sizes, specials by request. Details are available in Bulletin No. 7 from SHAKEPROOF, INC., Dept. 7-00, 2501 N. Keeler Ave., Chicago 39, Ill., or use INFORM-A-GRAM Key No. 700-S.

THE SELF-CONTAINED, EASILY INSTALLED, one-piece Bijur window unit requires no screws or gaskets to set it securely in place on the machine. Featuring a special oil-proof synthetic gasket which insures permanent oil tightness between window and frame, the housing has a bright metal background which provides sharp visibility of liquid level, flow, or drip and observation of the position or movement of parts. A special illustrated booklet can be obtained from BIJUR LUBRICATING CORP., Dept. 75, Long Island City 1, N. Y., or use INFORM-A-GRAM Key No. J75-S.

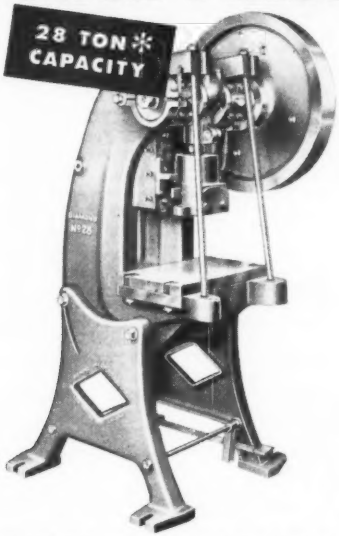
DESIGNED TO HANDLE HEAVIER LOADS AT HIGHER SPEEDS, the new line of "Hi" Live Centers eliminates friction in the head and tailstock. Incorporating matched and preloaded roller bearings, these live centers operate without chattering with an eccentricity point held to .0002", free and under load. Additional data about these live centers may be obtained by writing HOLUB INDUSTRIES, INC., Dept. 76, Sycamore, Ill., or use INFORM-A-GRAM Key No. J76-S.

THIRTY-SIX OF THE 1200 WAYS that Master Drive can convert your old machines from line shafts to independent operations are reviewed and pictured in the new 8-page Master Drive catalog showing lathes, milling machines, grinders, boring mills, presses, planes, and die sinkers. "Master Drive Makes New Tools from Old Ones" will be sent upon request from THE MASTER ELECTRIC CO., Dept. 3, Dayton 1, Ohio, or use INFORM-A-GRAM Key No. D83-S.

LIMITED PRODUCTION RUNS, EXPERIMENTAL AND LABORATORY MODELS are produced with the Sav-Way Pacemaker 1-oz Injection Molding Machine. Simplicity of design and operation makes it an outstanding labor and material saver. For answers to pertinent technical questions write SAV-WAY INDUSTRIES, MACHINE TOOL DIV., Dept. 16, 4875 E. Eight Mile Rd., Detroit 13, Mich., or use INFORM-A-GRAM Key No. 16-S.

PERMITTING HIGH CUTTING SPEED without corrosion, new transparent post-war cutting oils of Texaco now contain a combination of sulphur and chlorine. These "Cleartex" oils insure longer tool life as well as a better surface finish. Write for further data to THE TEXAS COMPANY, 135 East 42nd St., Dept. 57, New York, N. Y., or use INFORM-A-GRAM Key No. J57-S.

ANOTHER NEW *Diamond* inclinable open-back PUNCH PRESS



MASSIVELY BUILT with semi-steel castings for exceptional strength and rigidity. Large bed area and opening. Sliding surfaces precision ground and hand scraped. Positive, instant-acting clutch, extra heavy flywheel, streamlined design. NEW CIRCULARS AVAILABLE! Write today.

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Bed Opening . 6"x 9½"	Flywheel Speed 125 Max.

*5" Stroke maximum on special order

*OTHER DIAMOND PUNCH PRESSES AVAILABLE in 7, 9, 12, and 14 ton capacities. Write for literature

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PUBLICATION PREVIEWS

HARD OVERLAYING OF NEW PARTS is rapidly playing an important role in production. In the past this process has been confined to maintenance and resurfacing of worn parts. Hard overlaying is a process of welding onto the surface of parts subject to wear, a layer, edge, or point of metal which will have high resistance to the wearing factor. This process is fully described in the Eutectic Welder for July 1946. Copies are available from THE EUTECTIC WELDING ALLOYS CORP., Dept. 81, 40 Worth St., New York 13, N. Y., or use INFORM-A-GRAM Key No. 81.5-S.

SHOWING EXACTLY HOW AN INDEPENDENT ENGINEERING organization functions and the scope of its services, "The Answers to Industry's Problems", a brochure just issued by the Pioneer Engineering and Manufacturing Co., clearly and systematically takes a look at common production and organization problems. It will be of special interest to business and engineering executives. Write for a copy to PIONEER ENGINEERING AND MANUFACTURING CO., Dept. 83, 19669 John R. St., Detroit 3, Mich., or use INFORM-A-GRAM Key No. J83-S.

CLEANING, RINSING AND DRYING METAL PARTS by portable, drum, and continuous type washing machines are described and illustrated in Bulletin No. 6E1 by Optimus. Feature of this book is a table showing how seven basic type units can meet and handle twelve operating conditions. Copies of this bulletin are obtainable from OPTIMUS EQUIPMENT CO., Dept. 99, 165 Church St., Matawan, N. J., or use INFORM-A-GRAM Key No. D99-S.

ALMOST EVERY TYPE OF RIVETING PROCESS AND PRODUCT from heavy metals to eyeglass frames is handled by versatile Townsend Riveting Machines. Hollow rivets can be also accurately set without distorting the hole and in locations inaccessible to other machines. Information is available from THE H. P. TOWNSEND MANUFACTURING CO., Dept. 53, Hartford 1, Conn., or use INFORM-A-GRAM Key No. J53-S.

DESIGNED TO WITHSTAND REPEATED PULSATION, VIBRATION, and abnormally high overpressures, the Supergauge is a heavy duty type pressure gauge suitable for severe industrial service, and is styled to be read at greater distances than any other dial type gauge. Additional information is available from the U. S. GAUGE DIVISION OF AMERICAN MACHINE & METALS, INC., Dept. 82, Sellersville, Pa., or use INFORM-A-GRAM Key No. J82-S.

WIDELY USED IN RIVETING, forming, light broaching, crimping, stripping, heat sealing and assembly operations, Air Hydraulic Presses having controlled ram pressure, adjustable stroke, and ram speed are described in an 8-page bulletin available from AIR-HYDRAULICS, INC., Dept. 51, 120 W. Middle St., Chelsea, Mich., or use INFORM-A-GRAM Key No. J51-S.

FORMING SHALLOW SWEEPS AND DRAWING CONE-SHAPED AND TAPERED STAMPINGS become easy operations when the new Whistler Hydrodynamic Process for embossing and drawing sheet metal is employed. Featuring a fluid punch exerting uniform pressure, difficult stampings are turned out in only one operation at lower production cost. Details about this new process are clearly given in the illustrated 12-page booklet now available from L. V. WHISTLER or S. A. WHISTLER, Dept. 69, 748 Military Rd., Buffalo 17, N. Y., or use INFORM-A-GRAM Key No. J69-S.

HOLDING TEMPERATURE TOLERANCES AS CLOSE AS 1/5 DEGREE F. and attaining on-off cycles as short as 3 seconds, the Xactline Straight Line Temperature Control operates easily, inexpensively, and accurately in conjunction with milli-voltmeter or potentiometer type controlling pyrometers. Requiring no special adjustments, this instrument performs on electrically heated furnaces, ovens, or other industrial equipment. A thorough explanation of this new instrument is given in the brochure now available from the CLAUD S. GORDON CO., Dept. 7-59, 3000 S. Wallace St., Chicago 16, Ill., or use INFORM-A-GRAM Key No. 759-S.

LASTING UP TO 50 TIMES LONGER than ordinary steel drills and speeding up drilling work by 75%, the new type Metro Standard Carbide Tipped Masonry Drills accurately and quietly drill concrete, tile, slate, and brick. Recommended widely in connection with building maintenance, Metro drills can be used in any rotary portable electric drill. An illustrated bulletin and price list will be sent on request by METRO TOOL & GAGE CO., Dept. 9, 4240 W. Peterson Ave., Chicago 30, Ill., or use INFORM-A-GRAM Key No. 9-S.

COMBINING SPEED AND WEAR RESISTANCE with ability to take sharp cutting edge angles, the new cutting metal produced by Vanadium-Alloys Steel Co. has cobalt and 5% vanadium content combined with 1.5% carbon. Found valuable in machining hard cast iron and cast steels, as well as wrought metals, "Vasco Supreme" will operate at speeds 15 to 100% higher than 18-4-1 and 6-6-2 high speed steels. For their new descriptive literature, write to VANADIUM-ALLOYS STEEL CO., Dept. 71, Latrobe, Pa., or use INFORM-A-GRAM Key No. J71-S.

SOLDERING, OPEN FLAME WORK, BRANDING AND LABORATORY OPERATIONS are performed by Schmidt soldering and open flame torches to double production per man hour. The torches start without generating, give soldering heat in less than a minute,

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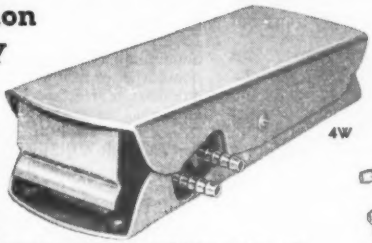

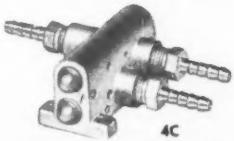

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and can be used with gasoline, bottled, natural or artificial gas. They are lightweight and give steady, even heat which permits uninterrupted work. A folder from MINN-KOTA FOUNDRY AND MFG. CO., Dept. 8-03, Fargo, N. D., gives details, or use INFORM-A-GRAM Key No. 803-S.

DESIGNED ESPECIALLY FOR ZAMAC OR ZINC ALLOY die castings, new Die Slick No. 11 lubricant is a colorless, odorless compound which will not stain, corrode, form carbon, or cause objectionable smoke or gases. Preventing the formation of zinc oxide on cone pins and die cavities, Die Slick No. 11 is applied in a fine mist spray which eliminates scoring and sticking and assures easy ejection of the casting. For further data write G. W. SMITH & SONS, INC., Dept. 8-69, 5401 Kemp Rd., Dayton 3, Ohio, or use INFORM-A-GRAM Key No. 869-S.

TAKING IDEAS AND TRANSFORMING THEM INTO METAL is the specialty of the Merz Engineering Company, which offers American industry a fourfold service including experimental engineering, a standard gage division, a special gage and tool section prepared to design tools and jigs, and a fully equipped machine shop for the manufacture of special parts. These services are discussed in detail in recent literature which may be obtained from THE MERZ ENGINEERING COMPANY, Dept. 7-20, Indianapolis, Indiana, or use INFORM-A-GRAM Key No. 720-S.

BUILT TO HOLD ROUND, SQUARE, HEX OR FLAT STOCK, the 4-way vise embodying all the uses for machinists—pipe or tubing vises, finds perfect use for mechanics or skilled workers. It will not crush or mar delicate finishes, yet holds work firmly. A bulletin from HOLLISTON MACHINE WORKS, INC., Dept. 52, Green St., Holliston, Mass., tells all, or use INFORM-A-GRAM Key No. J52-S.

SAVING TIME IN DESIGNING, TOOL MAKING and providing the machinist with a more secure and adaptable means of holding work, WESPO improved fixture clamps are actually an integral part of a fixture assembly. Made in five different types, six sizes each, for various job requirements, these clamps are fully adjustable and allow speedy access to the work. Further details and illustrations are in Bulletin No. 22 now available from WEST POINT MFG. CO., Dept. 67, 19625 Merriam Court, Farmington, Mich., or use INFORM-A-GRAM Key No. J67-S.

DRILLING ACCURATELY SIZED HOLES BY HAND OR POWER in concrete, stone, asphalt, brick, plaster and other refractory construction materials, Super Masonry Drills are now available at reduced prices. Operation of these carbide tipped drills requires minimum time and effort. A list of drill descriptions and their new lower prices will be sent upon request from the SUPER TOOL CO., Dept. 1-68, 21650 Hoover Rd., Detroit 13, Mich., or use INFORM-A-GRAM Key No. 168-S.

SPOT, SEAM, OR FLASH-BUTT WELDING OF MAGNESIUM ALLOYS employs the same Taylor-Winfield techniques as are used on aluminum. Considering the rapidly gaining popularity of magnesium which features both lightness and strength, many readers will be interested in the article and photographs in the October issue of "Weld It", published by the TAYLOR-WINFIELD CORP., Dept. 75, Warren, Ohio. They will send copies on request, or use INFORM-A-GRAM Key No. G75-S.

LASTING LONGER, REDUCING SPOILAGE, AND PRODUCING FINER FINISHES in less setup time, Wetmore reamers, shell reamers, producers and heavy duty reamers are of high quality heat-treated vanadium alloy steel. Employing adjustable inserted blades, processed for extra skin toughness, Wetmore tools are designed to give precision and speed on every job. The new Wetmore Tool catalog tells how to cut production costs. It's available from WETMORE REAMER CO., Dept. 8-38, 420 N. 27th St., Milwaukee 8, Wis., or use INFORM-A-GRAM Key No. 838-S.

MAKING BORING BARS, MILLING CUTTERS, TOOL HOLDERS, and many other pieces requiring square holes, can be done faster and more economically with a new product recently developed. This is a square holed sleeve which consists of a round sleeve with a perfectly square hole broached through the center. The hole is tapped at one end to receive a back-up screw. The sleeve can be sweated or pressed into a drilled and reamed hole to make a square hole in a tool holder. Full details are given in literature available on request from STURDY BROACHING SERVICE, Dept. 34, 13414 Fenkell Ave., Detroit 27, Mich., or use INFORM-A-GRAM Key No. J34-S.

GRINDING RADIAL AND HELIX RELIEF simultaneously, and varied to suit all practical requirements, is accomplished easier on the new D-S grinder than regular angular back off relief grinding. Provisions are made for grinding any tool to 12 flutes with identical relief on each blade. Folder No. 46 fully describes this equipment and is available from the D-S GRINDER DIV., ROYAL OAK TOOL & MACHINE CO., Dept. 95, Royal Oak, Mich., or use INFORM-A-GRAM Key No. G95-S.

PRODUCING SOLID DIE CASTINGS, in aluminum, brass, or magnesium, by the high pressure cold chamber injection method, is described in literature issued by Lester-Phoenix, covering the HHP line of machines. These machines are designed to eliminate porosity, which arises from two sources: shrinkage voids and entrapped air and gases. It can be controlled and eliminated by sustaining

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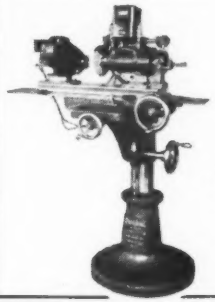

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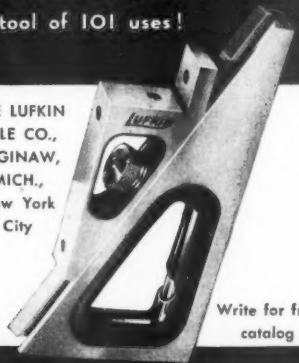

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high pressure on the metal as it chills. Copies of this literature will be sent on request from LESTER-PHOENIX INC., Dept. 4-25, 2711 Church Ave., Cleveland 13, Ohio, or use INFORM-A-GRAM Key No. 425-S.

LOCATING LAY-OUT CENTERS, on workpieces to be machined on a lathe, can be done quickly and accurately with the Variable Center Scope. The instrument is placed in a fixed position in the tailstock. With the workpiece strapped to the faceplate, the instrument is focused on the work. The workpiece is adjustable until the layout lines coincide with the guide line of the Center Scope. Full details are in literature available from CENTER SCOPE PRODUCTS, Dept. 5-85, 3829 San Fernando Rd., Glendale 4, Calif., or use INFORM-A-GRAM Key No. 585-S.

STARTING TORQUE WITH TURBINE-SMOOTH POWER has been incorporated into a new type of industrial hydraulic motor. This development, known as the Superdraulic Tri-port Motor, holds many advantages for industrial machine applications, including variable speed control, starting without clutches, and perfect control of acceleration and deceleration. Complete details are available from SUPERDRAULIC CORP., Dept. 82, Dearborn, Mich., or use INFORM-A-GRAM Key No. H82-S.

GRINDING 0" TO 1" RADII ON CUTTERS FROM 4" TO 12" DIA. having flute lengths up to 3" is accomplished with the No. 2 Radius grinding attachment, for use on Cincinnati No. 2 Cutter and Tool Grinders. Adjustment to the desired radius is obtained through a micrometer gage, inserted into a tapered hole which is bored concentric with the swivel point of the attachment. Complete data, including set-up hints, is given in publication No. M-1442, available on request from THE CINCINNATI MILLING MACHINE CO., Dept. 2-33, Cincinnati 9, Ohio, or use INFORM-A-GRAM Key No. 233-S.

ACCURATE DUPLICATION OF PARTS, concentricity within .0001", and shoulder lengths held identical on any number of pieces, are performances possible with the Cent-A-Matic lathe center. A small center tip is replaceable when worn or damaged. Lathe and grinder applications are illustrated in literature available from ACME-DANNEMAN CO., INC., Dept. 33, 203-205 Lafayette St., New York, N. Y., or use INFORM-A-GRAM Key No. J33-S.

STRENGTH AND POWER FOR HEAVY OPERATIONS, with all necessary refinements for accuracy and long life, are characteristics built into Diamond Millers. The three models available are described in literature which will be sent on request from the DIAMOND MACHINE TOOL CO., Dept. 2-68, 3429 East Olympic Blvd., Los Angeles 23, Calif., or use INFORM-A-GRAM Key No. 268-S.

GRINDING, DRILLING, SCREW DRIVING, AND NUT SETTING operations, performed with air tools, are described in a 40-page catalog, No. 46, now ready for distribution by Aro. Special application tools, tool room kits, balancers for suspending all types of tools in production work and many other accessories are also listed. For copies of this catalog write THE ARO PNEUMATIC CORP., Dept. 32, Bryan, Ohio, or use INFORM-A-GRAM Key No. 195-S.

TOOL CHANGE ON POWER TOOLS CAN BE MADE in three seconds without the necessity of shutting down the motor when Rayco Quick Change Chucks are part of the tool equipment. Employing the principle of centrifugal force to move a ground and hardened driver into the adaptor slot, the chuck operates in all positions at any speed. This chuck is self-centering and utilizes a positive centrifugal lock. An informative, illustrated folder will be sent upon request from RAYCO MANUFACTURING CO., Dept. 89, 3911 S. Prairie Ave., Chicago 15, Ill., or use INFORM-A-GRAM Key No. J89-S.

INSTALLATION OF MODERN MOTOR DRIVES permits the removal of old-fashioned line shafts and assures a cleaner, lighter shop which never has to be shut down completely for machine replacement or repair. Designed for lathes, screw machines, milling machines and presses, Modern Motor Drives feature fast, positive cam control to keep the belt in proper tension for transmitting power to the machine. Write for descriptive literature to MODERN MOTOR DRIVES DIVISION OF NICHOLS ENGINEERING CO., Dept. 24, 2400 W. Madison, Chicago 12, Ill., or use INFORM-A-GRAM Key No. G24-S.

APPLICATIONS REQUIRING HIGHLY ACCURATE CIRCUIT TIMING will find the Electronic Interval Timer Model 1029 precise and readily accessible. With a range of 0 to 2 min. in 1 sec. steps, the unit controls loads to 500 w at 125 v ac, is conveniently operated with switches and push-button, and recommended for all industrial applications. Information is available from ELECTRONIC CONTROLS, INC., Dept. 30, 44 Summer Ave., Newark 4, N. J., or use INFORM-A-GRAM Key No. J30-S.

DESIGNED TO INCLUDE MANY FEATURES that are exclusive and entirely new to the trade, Acme Broach Corp. has recently started production on broaching machines and tools. The Horizontal Hydraulic Broaching Machines, Acme Automatic 4-Jaw Broach Pullers, Acme Hydraulic Presses, Keyway Broach Pullers and standard Keyway Broaches are described in bulletins available upon request from ACME BROACH CORP., Dept. 32, E. Third St. at Delaware, Lexington 47, Ky., or use INFORM-A-GRAM Key No. J32-S.

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CERROMATRIX—250° F. For securing punch and die parts; anchoring machine parts; short run forming dies, etc.
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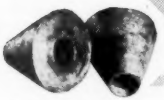

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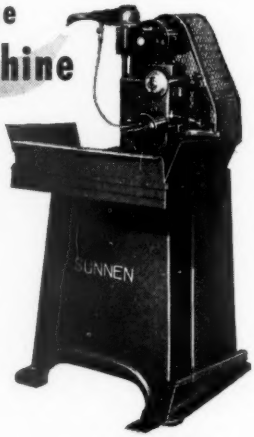

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Hones Any Metal *(including Nitrided Steels and Sintered Carbides)* ***or Plastic,*** except lead and babbitt, including glass and ceramics.

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Easily and quickly set up — no jigs or fixtures — skilled labor is not required.

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"FORMING PRESS DIES" AND THEIR USES, published by Dreis and Krump Mfg. Co., presents to the die designer simple designs covering everyday needs and many odd types. Information given is also of interest to the press operator. Production engineers and estimators will find short-cuts in the design of odd shaped dies particularly adapted for producing many "out of the ordinary" bends. This book, or any information as to the correct dies and the most efficient and economical method of handling the job, is available upon request from the Dreis and Krump Mfg. Co., Dept. 37, 7400 Loomis Blvd., Chicago 36, Ill., or use INFORM-A-GRAM Key No. F37-S.

VOLUME I OF AN INSTRUCTIONAL PROGRAM, covering contour sawing and filing in all its aspects, applications, operational techniques, and all phases of sawing and shaping in all types of material, has recently been published by The DoALL Co. Primarily intended for use in educational and vocational

institutions, this book will be extremely useful in the instruction of trainees. Divided into two sections, conventional and high speed sawing procedures, the book includes work projects and tests to be given trainees as well as grading data. For full details write The DoALL Co., Dept. 6-96, 1301 Washington Ave. South, Minneapolis 4, Minn., or use INFORM-A-GRAM Key No. 696-S.

SELECTING ALLOY STEEL TO MEET SPECIFIC REQUIREMENTS is facilitated with Carpenter's new booklet "2 Steels Simplify Your Alloy Needs". This new program, consisting of two steels that will meet approximately 95% of the users' steel demands, not only simplifies selection but inventories as well. These special purpose alloy steels are made in a tool steel mill, to the highest quality specification and inspected by tool steel standards. Type analysis and other descriptive data are available on request from Carpenter Steel Co., Dept. 38, General Office, Reading, Pa., or use INFORM-A-GRAM Key No. B38-S.

"INDUCTION HEATING" is a comprehensive 59-page bulletin covering the general history, principles and applications of induction heating, as well as dealing specifically with many of induction heating's most technical considerations. Noteworthy applications: surface hardening, heat treating, normalizing and annealing, brazing and soldering, heating for forging and forming are analyzed. The booklet, complete with pictures, charts, and graphs, is available upon request from Tocco Division, The Ohio Crankshaft Co., Dept. IH, 3800 Harvard Ave., Cleveland 1, Ohio, or use INFORM-A-GRAM Key No. 415-S.

SELECTING STAINLESS STEEL SEAMLESS TUBING is made easy with the help of a new booklet now available. Giving information about the characteristics and applications of seven stainless steels, this literature includes several tables which break down each analysis type according to its chemical analysis, mechanical properties, government specifications, physical properties, and temper and finish. The electric furnace process is reviewed in conjunction with the applications of stainless steel. Copies of this helpful material, "A Guide for the Selection of Seamless and Redrawn Welded Stainless Steel Tubing", is obtainable from Summerill Tubing Company, Dept. 95, Bridgeport, Montgomery County, Pa., or use INFORM-A-GRAM Key No. 195-S.

SHOP AIDS

CLEARLY UNDERSTANDABLE TO HIGH SCHOOL STUDENT and business executive alike, a new 36-page booklet, "The ABC's of Modern Plastics", provides a brief outline of the origin, preparation, and uses of plastics. Complex technical processes are described in terms of everyday living and further explained in colorful charts and lively illustrations. The influence of plastics has revolutionized many common manufacturing methods. Copies of this booklet are available upon request from the Bakelite Corp., Dept. 7-22, 300 Madison Ave., New York 17, N. Y., or use INFORM-A-GRAM Key No. 722-S.

CHEMICALLY FINISHING ALUMINUMS through a new process known as chemoxiding produces a beautiful lustrous glossy finish. Relatively hard and of excellent corrosive resistance, no paints, enamels or lacquers are required. Chemoxiding may be accomplished in the plant of the manufacturer, fabricator or in outside contract job shop. Detailed information on this process will be furnished on request by Colonial Alloys Co., The Technical Processes Div., Dept. 5, Philadelphia 29, Pa., or use INFORM-A-GRAM Key No. K5-S.

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A GUIDE TO PROPERTIES AND APPLICATIONS OF 18 RECENT METALLURGICAL DEVELOPMENTS is presented in booklet B-3369 for engineers and designers in communications, electronic, and other fields. Characteristics of magnetic metals and alloys are discussed; electrode, filament and contact metal properties and applications of tungsten, molybdenum and Cupaloy are described. Glass sealing alloys are outlined, and brazing and soldering alloys covered. A table lists physical and electrical characteristics of new metals and alloys compared with commonly used materials. Sketches, diagrams, curves and tables present detailed data on properties and applications of each material. A copy may be secured from Westinghouse Corp., Dept. 35, Box 868, Pittsburgh 30, Pa., or use INFORM-A-GRAM Key No. 35-S.

"INTRODUCTION TO MAGNESIUM AND ITS ALLOYS," by John Alico, is the first comprehensive work on the subject to be published in this country, although magnesium and magnesium alloys have been known and used in the United States for almost thirty years.

This book covers the fundamentals of production and fabrication for those manufacturers and design engineers who may be considering magnesium alloy applications for their particular products, and for research engineers, metallurgists, and students who desire aid in their work.

Copies of this book may be ordered from Ziff-Davis Publishing Co., Dept. TJ, 185 North Wabash Ave., Chicago 1, Ill., or 350 Fifth Ave., New York 1, N. Y. Price $5.00.

DATA OF BASIC IMPORTANCE in the assembly of aircraft engines, which will also be of benefit in the assembly of automotive engines, are covered in the recent report, "Torquing of Nuts in Aircraft Engines," published by the Society of Automotive Engineers. The report investigates the causes of bolt and stud failure and the means for avoiding such failures, which, some experts feel, have not been fully understood. Design, production and maintenance engineers, metallurgists and all assemblers of mechanical equipment will find in the report extensive data obtained from laboratory tests, which were confirmed by tests in actual service. Copies are available from Special Publications Dept., Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N. Y. $2.00 to SAE members; $4.00 to non-members.

"KENNAMETAL CEMENTED CARBIDE PRODUCTS" published by Kennametal, Inc., contains complete buying information, describes and illustrates proper selection and application of Kennametal Tools, and gives instructions on methods of use and maintenance that insure maximum performance. Steel cutting Kennametal is made in five standard compositions, having graded properties to meet a wide range of usefulness. Copies of catalog 46 are available upon request from Kennametal, Inc., Dept. 33, Latrobe, Pa., or use INFORM-A-GRAM Key No. 33.5-S.

"HYDRAULIC OILS FOR INDUSTRIAL EQUIPMENT" is the title of an article appearing in the August 1946 issue of "Lubrication", a Texas Company publication. The article includes discussion of maintenance problems and trouble shooting in hydraulic systems, methods of increasing their efficiency, and advantages accruing through the use of additives in the oils. The incorporation of additives in hydraulic lubricants results in oils which aid rust prevention, inhibit oxidation, reduce foaming, and maintain high standards of viscosity. A copy will be sent upon request from The Texas Company, Dept. 57, 135 East 42nd St., New York 17, N. Y., or use INFORM-A-GRAM Key No. J57-S.

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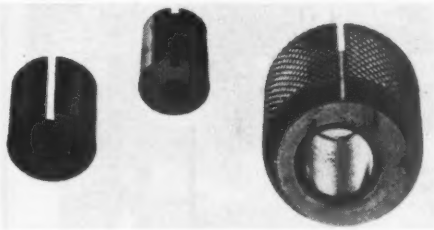

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Body Length	1/2	5/8	3/4	1	1	1

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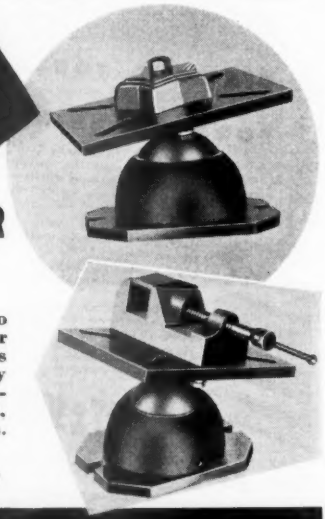

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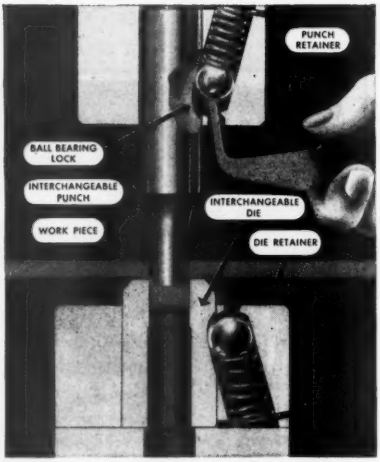

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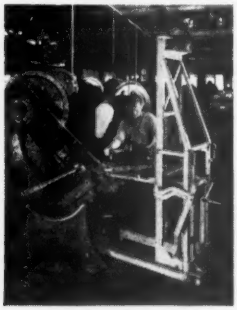

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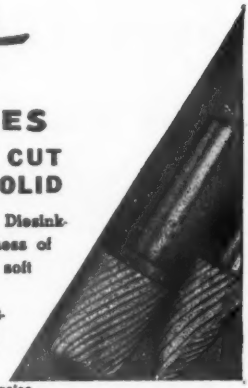

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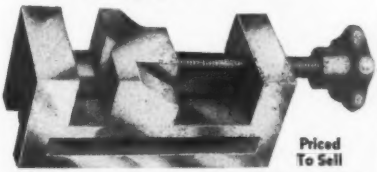

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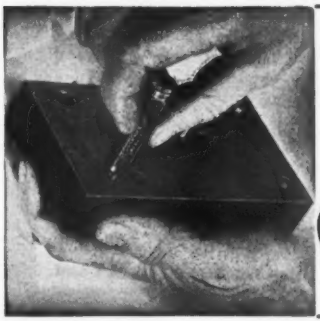

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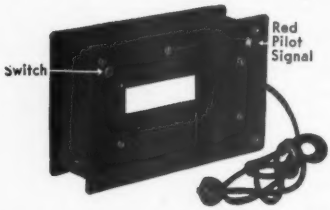

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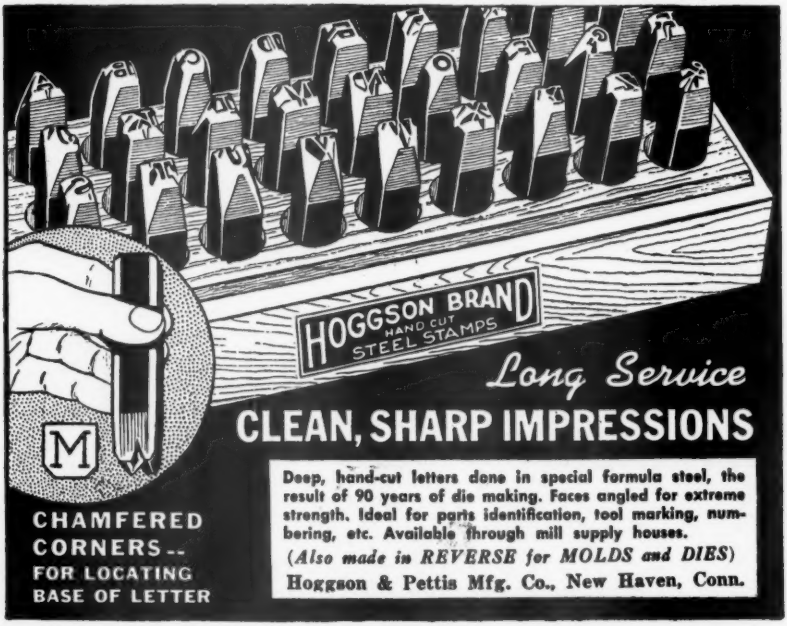

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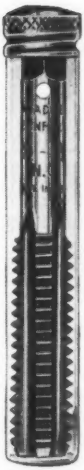

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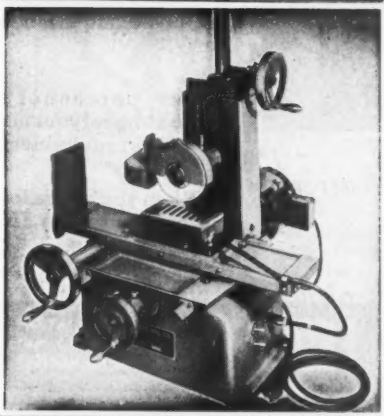

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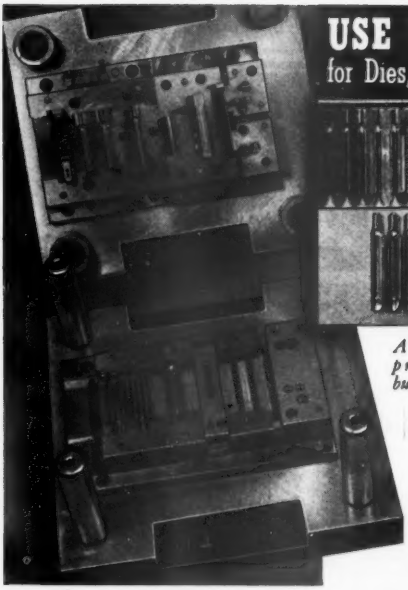

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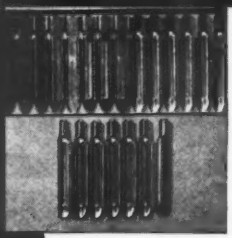

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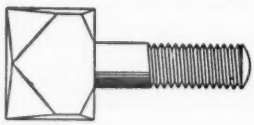

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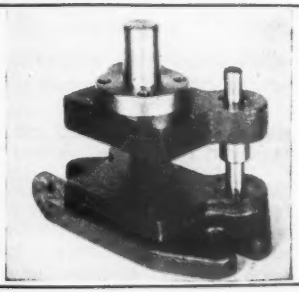

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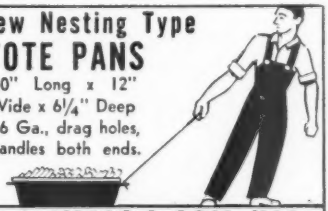

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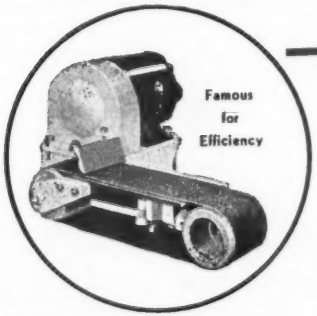

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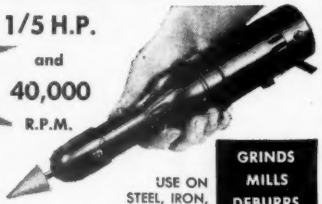
1/5 H.P.
and
40,000
R.P.M.



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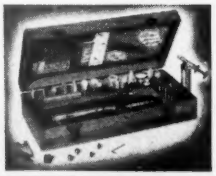
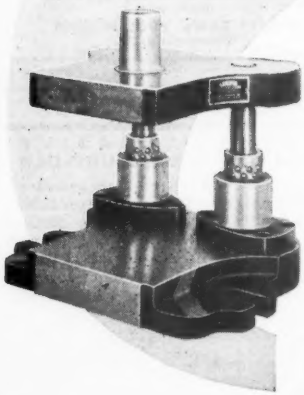
PRECISE 40



SAVE UP TO 60% OF DIE SETTER'S TIME WITH LEMPCO ANTI-FRICTION DIE SETS



On one die, Atlantic Tool and Die Company saved 40 hours of assembly and set up time, by using Lempco Anti-Friction Die Sets.

Lempco Anti-Friction Die Sets are equipped with ball or roller bearing guide pins. That's why dies can be set up by hand without the use of hammers, mauls, jacks or pry bars. This eliminates production delays caused by accidents to die and punches—saves up to 60% of die setter's time. Lempco Anti-Friction Die Sets positively eliminate all down-time caused by bound, scored or galled guide pins.

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Will Speed up Drilling
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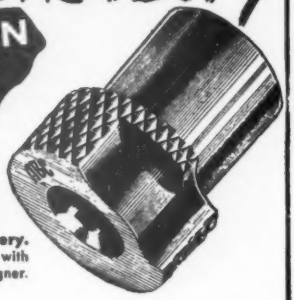

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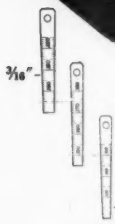

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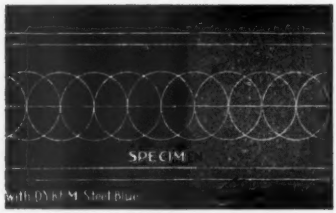

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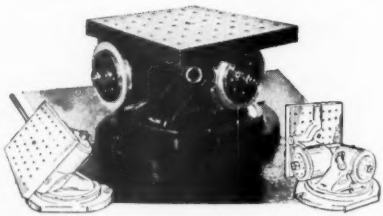

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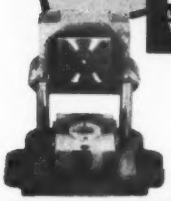

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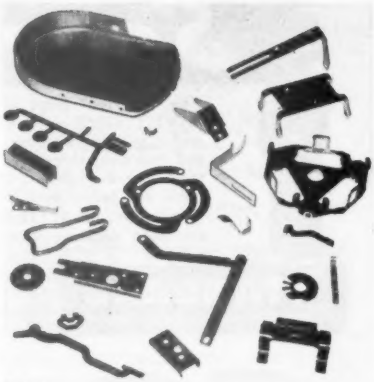

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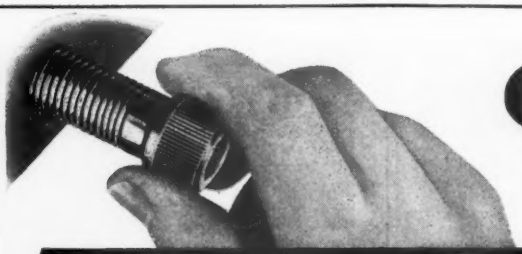

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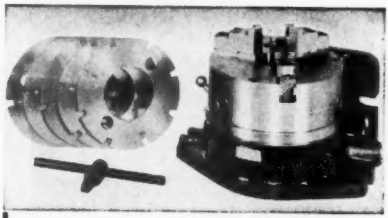

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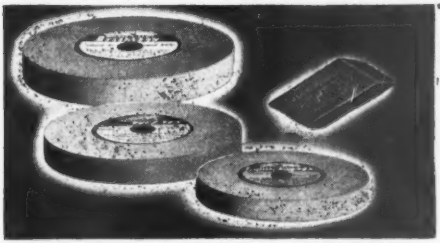

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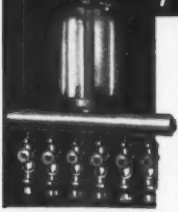
MULTIPLE LUBRICATION *Simplified*



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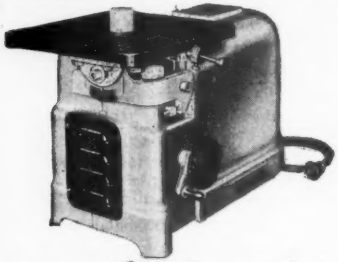

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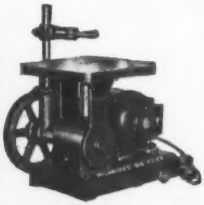

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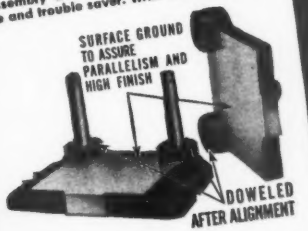

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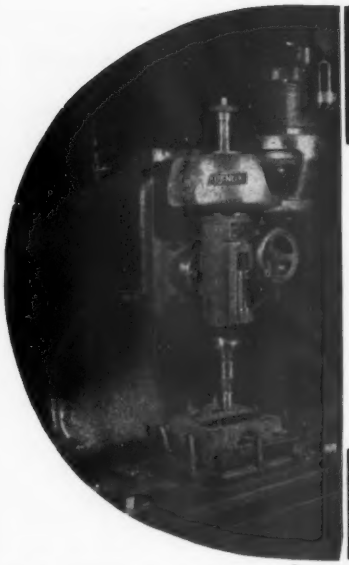

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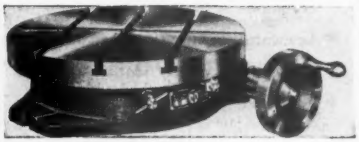

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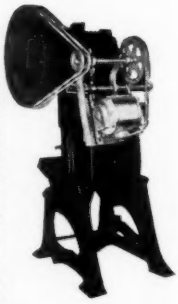

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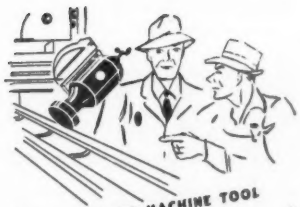

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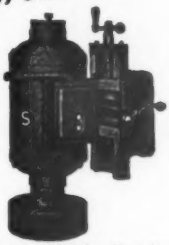

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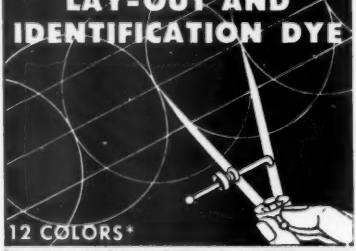

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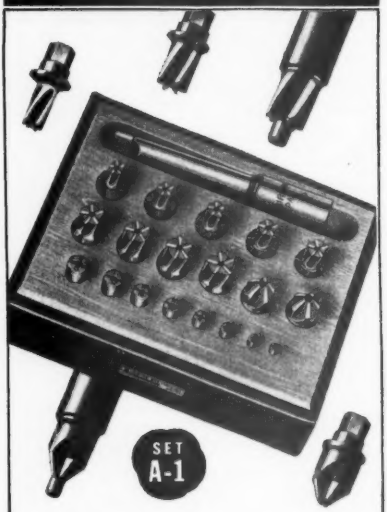

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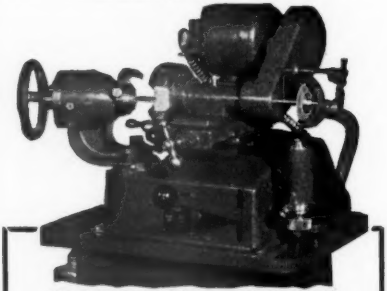

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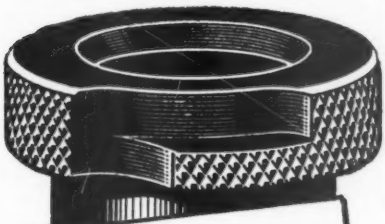

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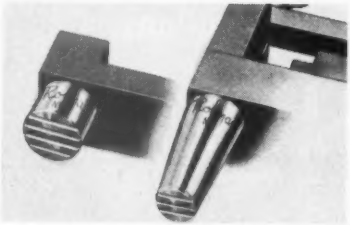

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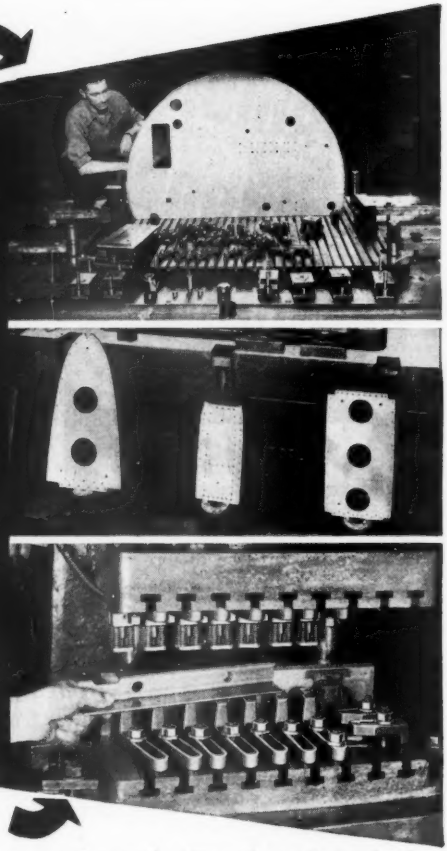

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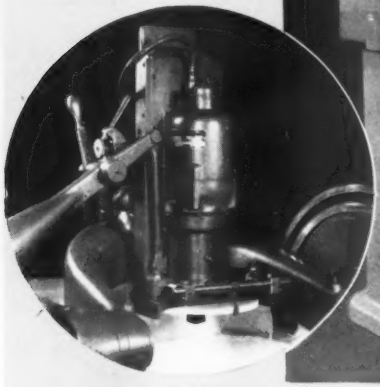
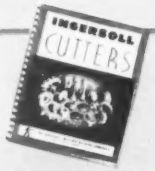
  Mounts in standard yoke. Write for quotation on new head.



- The Ingersoll Grinder sharpens in a single setting of the cutter the face, periphery and corners of cutters from 4" to 30" in diameter. It will also grind solid shank, radius, staggered tooth, and angular inserted blade cutters.

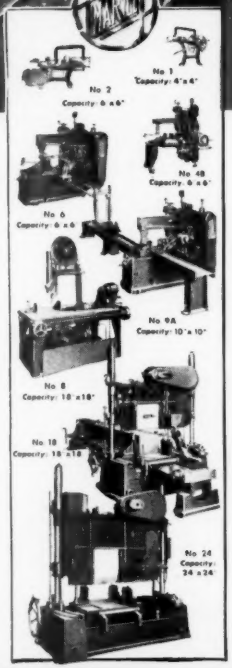
For more details, write for Bulletin 54A describing its wide range of application.



- Ingersoll also builds a complete line of inserted blade milling and boring tools with carbide tipped, cast alloy, or high speed steel blades — face mills, end mills, slotting cutters, helical slabbing mills, cylinder boring and combination boring, facing and chamfering tools.

Write for Bulletin 55A giving complete details on Ingersoll inserted blade milling and boring tools.

THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILLINOIS



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Steels just don't come too tough for MARVEL Giant Hydraulic Hack Saws. Take, for example, the three No. 18 MARVEL Saws, at the Babcock & Wilcox steel mill, shown above. These machines are used to cut test specimens for sample pieces of stainless and other tough alloy billets which are checked for seams, pipes, etc., before being drawn into tubing. It takes tough steel to make the best tubing, and it takes modern sawing equipment to cut it rapidly, accurately and economically.

With 10 types of metal-cutting saws, each available in a series of variations, MARVEL can furnish sawing machines that exactly meet your requirements. If you have a metal-sawing problem—call in the local MARVEL Sawing Engineer.

Write for MARVEL Catalog or check it in your Sweet's Catalog Files.

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